JOHNSTONE STRAIT KILLER WHALE *Committee*

Background Report

Province of British Columbia

BC Parks

Fisheries and Oceans

Pêches et Océans

91-04452/

Canadian Cataloguing in Publication Data
Johnstone Strait Killer Whale Committee (Canada)
Background report

Co-published by Dept. of Fisheries and Oceans.
ISBN 0-7726-1344-3

1. Killer whale - British Columbia - Johnstone Strait - Effect of habitat modifications on. I. British Columbia. Ministry of Lands and Parks. II. Canada. Dept. of Fisheries and Oceans. III. Title

QL737.C432J63 1991 639.9'7953 C91-092172-5

PROLOGUE

Attitudes of society towards killer whales have changed radically in the past 30 years. In 1960, killer whales were considered nuisances...

> *"It is recommended that one .50 calibre machine gun with tripod mounting be used [at Seymour Narrows] with ball ammunition only... If the whales approach from the westward, method of attack would be to open fire when they approach... in an endeavour to turn the herd back and so prevent them from entering Seymour Narrows and continuing on to the Campbell River area... Should the whales approach from the Campbell River side, it would be preferable to withhold fire until they have passed to the westward of the gun position, to prevent turning back toward Campbell River."*
>
> Partial Terms of Reference of a committee struck by the Federal Department of Fisheries to reduce the number of killer whales at Campbell River [letter dated 28 July 1960].

In the 1990's, killer whales are viewed as important contributors to marine ecosystems and have become symbolic barometers of environmental health...

> *"The goal of the Department of Fisheries and Oceans and of the Ministry of Parks is to ensure that human activities [commercial fishing, whale watching, and logging] do not discourage killer whales from using Johnstone Strait, and in particular from using Robson Bight Ecological Reserve... The proposed management options... [include] the protection of killer whale habitat in the Robson Bight area."*
>
> Partial Terms of Reference for the Johnstone Strait Killer Whale Committee announced on 7 May 1990.

FOREWORD

The federal Minister of Fisheries and Oceans and the British Columbia Minister of Parks jointly appointed the Johnstone Strait Killer Whale Committee to examine the impacts of human activity on killer whales in Johnstone Strait. The mandate of the Committee is:

- to assess the importance of Johnstone Strait and Robson Bight to killer whales;
- to assess the impact of human activities on killer whales and their environment; and
- to recommend management options that will ensure the continued presence of killer whales in Johnstone Strait and at Robson Bight.

To develop the best management options, the Committee was asked to examine impacts of all human activities within the Robson Bight (Michael Bigg) Ecological Reserve (RBMBER) and the impact of whale watching in other areas of Johnstone Strait. The Committee's expertise to address the management issues includes whale biology and habitat, resource management in ecological reserves, commercial fisheries, tourism, forestry, and Native affairs.

Three ground rules will guide the Committee in making its final recommendations to the federal and provincial governments.

1. **The primary objective is to ensure the continued presence of killer whales in Johnstone Strait and to maintain traditional patterns of use and occurrence.**

2. **Decisions will give priority to environmental concerns but will also consider economic and social concerns.**

3. **Fairness and equity will be objectives for decisions regarding human resource use, with user groups being involved in the decision-making process.**

The Committee is seeking public input before any final management recommendations are formulated. This Draft Background Report of the Johnstone Strait Killer Whale Committee outlines issues and some options for managing resource use with regard to killer whales. Proposed options and some preliminary recommendations are included to stimulate discussion.

We need your help if we are to make the best recommendations to the provincial and federal governments for protection of killer whales and their habitat. To provide information and receive comments, the Johnstone Strait Killer Whale Committee will be hosting open houses (3-7 pm) and public meetings (7-10 pm) at the following locations:

Campbell River	***June 11***	*Discovery Inn*	***Victoria***	***June 19***	*Newcombe Auditorium*
Port McNeill	***June 12***	*Lions' Hall*	***Vancouver***	***June 20***	*Robson Conference Centre*

Members of the public will be given the opportunity for brief (5 minute) presentations. In addition, written submissions will be accepted until July 19, 1991. A revised background report will be distributed to key groups for additional comments, prior to submission to the respective government agencies. A final report will be released to the public in fall 1991.

THE JOHNSTONE STRAIT KILLER WHALE COMMITTEE

EXECUTIVE SUMMARY

BACKGROUND

Northern Johnstone Strait is known as one of the best areas in the world to view and study killer whales. In 1982, the province of British Columbia established a marine ecological reserve in the Strait to protect special killer whale habitat. An upland portion was added to this reserve in 1988-89, and the area is now known as Robson Bight (Michael Bigg) Ecological Reserve (#111).

Until 1970, killer whales shared the waters of Johnstone Strait mainly with merchant traffic and commercial fishing vessels. Since then, the scale of human activities in the region has grown dramatically and a highway completed in 1979 from Campbell River to Port Hardy now makes the area easily accessible. As a result, much more marine activity is observed in Johnstone Strait than in the past.

Recently, concerns have arisen that human activities such as whale watching, logging, and commercial fishing cumulatively threaten continued use of the area, particularly the rubbing beaches, by killer whales. In response to these concerns, the B.C. Minister of Parks (BC Parks) and the Minister of Department of Fisheries and Oceans (DFO) jointly appointed the Johnstone Strait Killer Whale Committee to provide a background report and to recommend management options to ensure the continued presence of killer whales in Johnstone Strait.

The Committee's background report defines issues and outlines preliminary recommendations for public review and comment. This document describes:

- the importance of Johnstone Strait and Robson Bight (Michael Bigg) Ecological Reserve (RBMBER) to killer whales;
- the patterns of human activities in these areas;
- the impacts that these activities may have on killer whales and their habitat; and,
- management options and preliminary recommendations to deal with these issues.

This report is being distributed widely to the public and interest groups, including Native groups, in preparation for public meetings scheduled for June 1991.

IMPORTANCE OF JOHNSTONE STRAIT AND ROBSON BIGHT TO KILLER WHALES

Today, Johnstone Strait is widely known as the best location in the world to view and research killer whales in the wild. Up to 190 killer whales use Johnstone Strait each summer, primarily to feed on migrating salmon. Daily predictability of whale sightings and occasional concentrations of 50-100 whales in these sheltered waters offer unequalled opportunities for research and wildlife viewing of these complex and visually impressive animals.

Over 90% of the killer whales that enter Johnstone Strait each summer also frequent the Robson Bight area to socialize, rest and rub on pebble beaches. Rubbing behaviours have been rarely seen elsewhere and nowhere else have these behaviours been observed with such frequency or involving such large numbers of whales. Recent studies have shown that killer whales in Johnstone Strait spend as much as 20% of their time in RBMBER, with that time divided almost equally between the Bight itself, the rubbing beaches, and the remainder of the Reserve.

OVERVIEW OF HUMAN ACTIVITIES

Resource use in and around Johnstone Strait primarily involves forestry, commercial and sport fishing, tourism and transportation. In 1989, northern Vancouver Island accounted for 8% of the provincial timber harvest and 13% of the annual salmon catch. The area received over 270,000 visitors in 1988, of which 8,000 watched killer whales in Johnstone Strait.

POTENTIAL SOURCES OF DISTURBANCE TO KILLER WHALES

The northern resident population of killer whales is increasing at a rate of 3% per year, a relatively rapid growth rate for species with a potential lifespan of 50-75 years. Currently, this growth rate does not reflect long-term negative effects of human activity in Johnstone Strait or elsewhere in their range. Disturbance of killer whales by commercial fishing and shipping outside the reserve appears to be minimal. On the other hand, there are indications that viewing, research and photographic activities focused on the whales may result in short-term disturbance of whales. As the level of these activities increases, whale disturbance will also increase, especially in the absence of effective control.

Within RBMBER, a three-year study by BC Parks indicates that short-term disturbance takes place if killer whales are approached from land or water. Thus, it appears that killer whales have reduced their use of habitat in an area specifically set aside for their protection.

Commercial fishing in RBMBER, accounted for the majority of vessel approaches at or near the rubbing beaches and the majority of disturbance reactions by killer whales. Potential disturbance by whale watching boaters, commercial charters, researchers and photographers was low, partly due to education, management and the seasonal presence of ecological reserve information officers.

Land access and forestry activities are of concern because of their proximity to sensitive killer whale habitat. Logging is taking place both in the Tsitika watershed behind the Bight area, and in the Schmidt Creek drainage, directly east of the rubbing beaches. The primary concerns are the possibility of increased amounts of sediments in the water and improved access to the area on logging roads. The effects of logging adjacent to RBMBER on killer whales and whale habitat are as yet undetermined. Access via logging roads is a major concern though as it has been shown that whales leave the area when people are on shore. With one exception only, people so far have been observed to gain access to the reserve beaches from the water as access via logging roads is currently difficult.

Threats to the integrity of killer whales' environment are often hard to detect because whales are at the top of the food chain and have a low reproductive rate. Despite research since the early 1970's, there are many unanswered questions regarding the biological requirements of these whales, such as "How important are Johnstone Strait and Robson Bight in the ecology of this population of killer whales?" Until such basic questions can be answered, management of human activities with short-term and potential long-term impacts on the whales must be conservative.

In Alaska, Hawaii and Baja California, vessel traffic has discouraged other species of whales from using breeding and feeding habitats. There is a concern lest a similar phenomenon occurs in Johnstone Strait. However, we can do much to mitigate negative impacts.

MAJOR MANAGEMENT CONSIDERATIONS

The key to protecting killer whales, besides ensuring the continued presence of salmon stocks and minimizing water pollution, is the management of people. Whether they are engaged in whale watching, logging or fishing, people are the most likely agents of change to killer whale habitat in Johnstone Strait. To manage such changes, a number of approaches can be used including: education, research, resource management, legislation and enforcement.

Education has been the most effective measure in reducing human impacts on killer whale populations in Johnstone Strait. Education measures are flexible, relatively fast to implement, and can be tailored to involve the very people who interact with whales as well as the general public. An education program is important as a continuing management tool to ensure the protection of whales, regardless of other methods used.

Long-term **research** is necessary to improve knowledge of these whales and to learn how best to minimize impacts to them and their habitat. Long-term research in Johnstone Strait has yielded the most significant information on killer whale populations in the world. However, many gaps in knowledge of their life history still exist, and need to be addressed to ensure whale protection.

Resource management is necessary in Johnstone Strait to balance the needs of resource users while minimizing impacts on killer whales and their habitat. When changes are required to the ways that resource harvesting takes place, decisions regarding resource management are best undertaken by involving user groups, both Native and non-Native, and the public. In addition to major effects from any individual factor, cumulative effects of all human activity in the region may cause damage.

Legislation and effective enforcement provides the "last resort" protection of killer whales and their habitat. Legislation can further minimize impacts of human activities and can strengthen education, research and resource management programs.

MANAGEMENT OPTIONS

A range of management options is presented for each major resource use likely to have an impact on killer whales in Johnstone Strait and at Robson Bight. Each option can be used in isolation or potentially in conjunction with other measures. These options do not necessarily represent the views of DFO or BC Parks but are offered as a range of possibilities to solicit public feedback.

COMMERCIAL FISHING

Some of the potential options for managing commercial fishing within RBMBER include:

- continue commercial fishing as at present;
- implement an education program for Native and non-Native commercial fishermen to reduce the impact of vessel traffic near whales;
- improve Marine Mammal regulations to minimize whale disturbance;
- restrict commercial fishing and mooring at the rubbing beaches and in the Bight itself, or in the entire Reserve.

WHALE WATCHING

Some of the options for managing whale watching in Johnstone Strait include:

- expand the public education program;
- establish a DFO seasonal program to inform whale watchers of appropriate conduct while whale watching, and implement whale watching guidelines or regulations;
- develop a special management area in Johnstone Strait;
- develop a land-based whale watching park away from Robson Bight;
- establish a licencing program for whale watching charters (with or without limited entry), or facilitate self-policing;
- form an advisory committee to provide a forum for public and user concerns;
- improve whale watching guidelines and/or Marine Mammal regulations;
- develop an appropriate permit system for researchers and photographers.

Options for Robson Bight include:

- maintain existing programs in RBMBER, ie. visitor education, research funding, and a permit system for researchers and photographers;
- close all or part of the Reserve to whale watching except by permit;
- delegate DFO to implement Reserve guidelines for whale watching or confer Fisheries Act powers to BC Parks to enforce federal guidelines or regulations for whale watching.

LAND ACCESS

Some of the options to limit potential disturbance of killer whales due to land access include:

- establish a land-based whale watching park at a site removed from the Reserve to reduce pressure on whales in the Reserve.
- continue roadbuilding but monitor gated access;
- defer or prohibit road construction near the Reserve;
- extend the Reserve eastward to limit access to the rubbing beaches and/or southward to limit access to the Bight;

FOREST MANAGEMENT

Some of the options for forest management include:

- continue harvesting as planned in the Tsitika and/or Schmidt drainages;
- include Schmidt Creek within the Tsitika Follow-up Committee's mandate;
- require special logging practices and monitoring to protect killer whales and their habitat;
- defer logging in the lower Tsitika and/or Schmidt drainages until further research is completed;
- discontinue logging in the lower Tsitika and/or Schmidt drainages;
- increase size of protected area to include visual backdrop to RBMBER;
- extend RBMBER eastward to include lower Schmidt Creek and/or southward of Bight.

OTHERS

- establish an ongoing advisory committee representing DFO, BC Parks, Native and non-Native user groups and the public to help implement the recommendations of this report, and to develop specific guidelines for managing whale viewing, fishing and other activities near the whales.

As with the present committee, objectives of the advisory group would be to minimize conflicts between human and whale activities in the area, and to ensure the continued and traditional presence of killer whales in Johnstone Strait and Robson Bight. The advisory group would also monitor and periodically review management practices, identify and review research projects, and maintain lines of communication for more effective resource management.

PRELIMINARY RECOMMENDATIONS

Where resource use conflicts with either killer whales, their habitat or other resource uses, the Johnstone Strait Killer Whale Committee needs public and user input prior to making final recommendations on resource management. However, proposals related to education, research and legislation can be more specific as these do not involve user groups to the same extent.

Hence, preliminary recommendations are presented here to solicit feedback from users and the general public. We fully expect modifications and/or new recommendations as a result of public consultation.

EDUCATION

Education is the most effective tool to minimize disturbance of killer whales, since most disturbance results from lack of awareness rather than poor intentions. Once informed, most people are generally very willing to comply with whale watching guidelines. Specific recommendations for education are as follows:

1. DFO should:
   - produce and widely distribute a pamphlet on whales and whale watching guidelines;
   - consider establishing educational programs in Johnstone Strait for commercial and recreational fishermen regarding whales and whale watching;
2. BC Parks should:
   - continue to distribute its pamphlet on whale watching guidelines in Robson Bight;
   - maintain the visitor information program at Robson Bight; and
   - consider offering slide or film presentations at campgrounds and communities in the vicinity to provide information on killer whales and proper whale watching behaviour.
3. Jointly DFO and BC Parks should:
   - conduct special educational programs in communities on northern Vancouver Island, especially prior to whale watching season; and
   - establish and manage a whale watching park in Johnstone Strait, away from RBMBER.

RESEARCH

Johnstone Strait and Robson Bight are globally significant locations for killer whale research. It is vital to support long-term research and to encourage new projects to fill remaining gaps in our knowledge of killer whales which are critical to adequate management. Specific recommendations for research are as follows:

1. DFO should continue to monitor killer whale populations, and support and encourage new killer whale research, including the establishment of an endowment fund, involving private sector participation, to promote research projects from Canadian universities.
2. BC Parks should continue to fund research into impacts of human activities on killer whales and their habitat at Robson Bight.
3. Jointly, DFO and BC Parks should:
   - establish a facility in Johnstone Strait to support both researchers and information staff and to promote the exchange of information regarding killer whales; and
   - cooperate with local universities and other whale research groups, such as West Coast Whale Research and the Vancouver Aquarium, in the formation of an association to promote information exchange and support research on killer whales.

LEGISLATION

Effective legislation is an important component of an overall management strategy for protecting killer whales. Improvements to existing legislation may be required. Specific recommendations are as follows:

1. DFO should, subsequent to the review of current Marine Mammal legislation, consider a more precise definition of whale "harassment" to provide adequate protection to whales from disturbance.
2. BC Parks should improve the ecological reserve regulations to better control land activities at Robson Bight.

RESOURCE MANAGEMENT

As stated earlier, recommendations regarding resource management can only be made after public consultation. The exception is the recommendation for an ongoing advisory committee discussed above in Management Options. The major issues that need to be addressed are related to human access to the reserve, by land or by water; commercial fishing activity in the reserve; and, whale watching activities in Johnstone Strait.

PUBLIC INPUT

Western Johnstone Strait and the Robson Bight (Michael Bigg) Ecological Reserve are outstanding special features of provincial and international significance in terms of killer whale research and viewing opportunities. In managing resource uses, we face some difficult issues. We would like your advice on how these issues should be addressed. It is important to view these issues ecologically, as it may be the collective impact of human activities which may disturb the whales or damage their habitat. Please help us to answer the question: "How can we best ensure that killer whales continue to use Johnstone Strait and Robson Bight in the spectacular concentrations and unique manner that they do presently?".

Table of Contents

Prologue i

Foreword ii

Executive Summary iii

Introduction 1

Study Area 5
- Western Johnstone Strait
- Robson Bight (Michael Bigg) Ecological Reserve 7

Biology of Killer Whales 8
- World
- British Columbia
- Western Johnstone Strait 11
- Robson Bight (Michael Bigg) Ecological Reserve 14
- Overview of Killer Whale Biology

Regional Overview of Human Activities 16
- Communities of Northern Vancouver Island
- Coastal Tourism/Whale Watching 18
- Other Marine-Based Activities 20
- Forestry 21
- Traditional Native Use and Land Claims 26
- Summary 27

Potential Disturbances to Killer Whales 28
Marine-Based Disturbance
Land-Based Disturbance 35

Killer Whale Responses to Activity 38
Short-Term Responses of Killer Whales
Long-term Responses of Killer Whales 41
Summary 45

Management Issues and Conclusions 46
Key Agency Roles
Commercial Fishing 50
Whale Watching, Research and Photography 51
Land Access 55
Forest Management 56

Management Approach and Options 59
General Approach
Specific Options 60
Commercial Fishing
Whale Watching in Johnstone Strait 62
Whale Watching in the Ecological Reserve 64
Land Access 65
Forest Management 66

Preliminary Recommendations 67
Education
Research 68
Legislation
Resource Management 69

References 70

Personal Communications 75

Acknowledgments 76

List of Tables

4.1 British Columbia Population Estimates for Mount Waddington Regional District 16
4.2 Selected Visitor Activities on Northeast Vancouver Island in 1988 19

Appendix 1
Terms of Reference for the Johnstone Strait Killer Whale Committee

Appendix 2
Statistical Areas used for Fisheries Management

Appendix 3
Robson Bight (Michael Bigg) Ecological Reserve (E.R. #111) Reports and publications

Appendix 4
Studies Completed in the Tsitika Valley (1981-1989) and Tsitika Follow-Up Committee Membership

Appendix 5
Management Experience Elsewhere
International Experience
National Experience

Appendix 6
Guidelines for Whale Watching
Barkley Sound and Clayoquot Sound
Johnstone Strait
Robson Bight (Michael Bigg) Ecological Reserve

List of Figures

1.1 Western Johnstone Strait 2
2.1 Robson Bight (Michael Bigg) Ecological Reserve 6
3.1 Resident Killer Whale Range in British Columbia 10
3.2 Mean Number of Whales Sighted per Month in Johnstone Strait 12
3.3 Frequency of Occurrence of Northern Resident Pods in Johnstone Strait, July-September 1984-88 12
3.4 Behavior Time Budget of Resident Killer Whales in Johnstone Strait 13
4.1 Communities on Northern Vancouver Island 17
4.2 Tree Farm Licences Adjacent to Western Johnstone Strait 23
4.3 Planned Forestry Activities for 1990-1995 for Areas Adjacent to Robson Bight (Michael Bigg) Ecological Reserve 25
5.1 Recreational Boat Encounters (%) with Whales in Johnstone Strait, 1986-89 29
5.2 Frequency Distribution of the Number of Vessels Simultaneously Encountering a Group of Whales 29
5.3 Mean Duration of Whale Watching Encounters in Johnstone Strait 30
5.4 Composition (%) of Vessel Traffic in Johnstone Strait . 31
6.1 Killer Whale Reactions to Vessel Approaches at the Rubbing Beaches 40
6.2 Occurrence of Northern Resident Killer Whales in Johnstone Strait 42
6.3 Occurrence of Southern Resident Killer Whales in Haro Strait, June-August 1980-1990 43
6.4 Number of Whale-Watching Operations in Haro Strait, Washington 44
6.5 Population Trends during 1960-87 in the Northern Community and the Southern Community 45
7.1 Present Management of Johnstone Strait Killer Whale Habitat 47

1.0 INTRODUCTION

Until about 20 years ago, killer whales shared the waters of Johnstone Strait mainly with merchant traffic and commercial fishing vessels. Since then, the scale of human activities in the region has grown dramatically. In the early 1970's, researchers began routine annual monitoring of killer whale abundance and behaviour. Through the 1970's, an increasing number of boaters travelled to the region to watch whales. A highway completed in 1979 from Campbell River to Port Hardy now makes the area more accessible (Fig. 1.1).

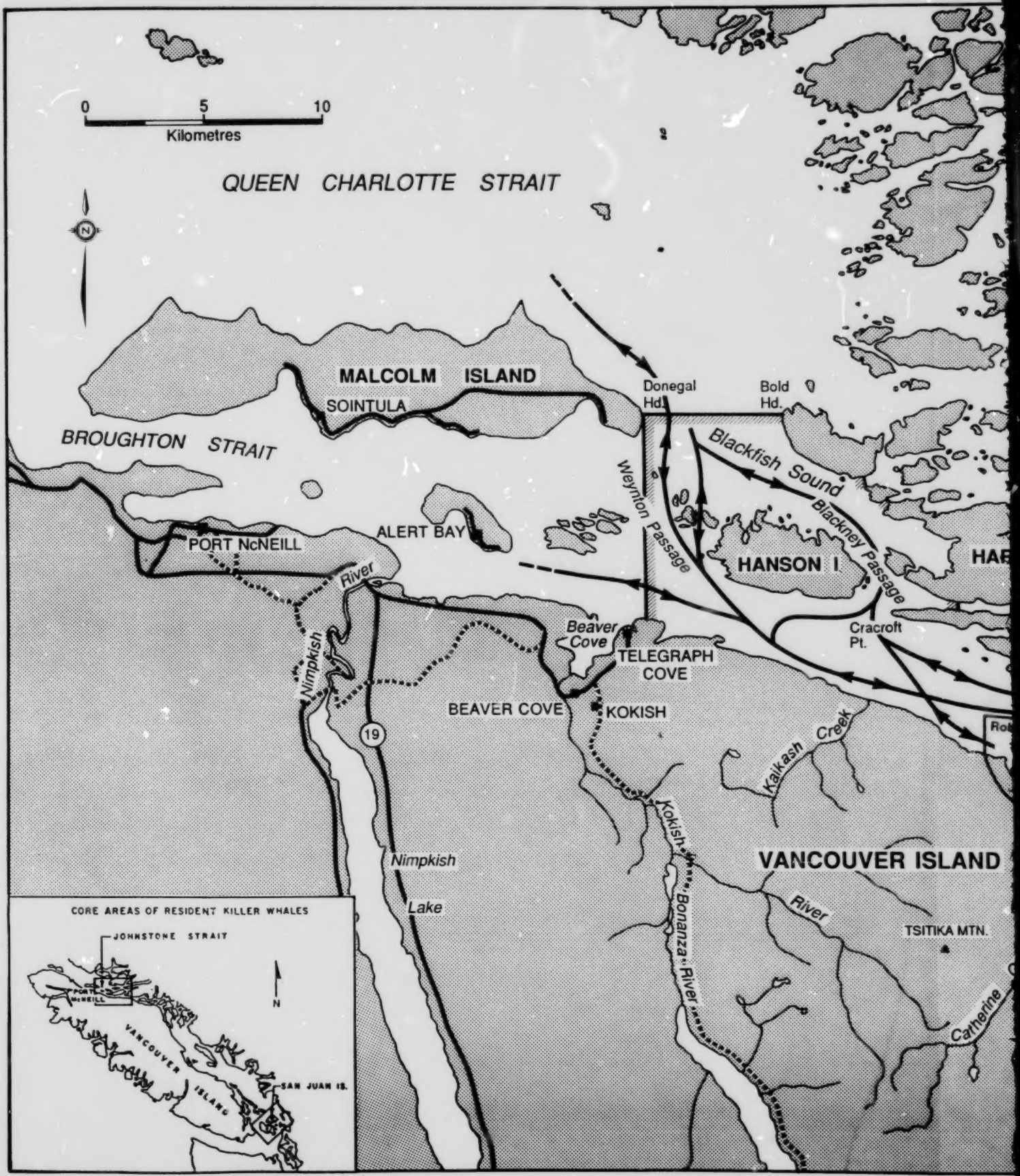
Today, Johnstone Strait is widely recognized as the best location in the world to view killer whales in the wild. Pods of killer whales enter Johnstone Strait daily during summer to feed on salmon, socialize, rest and to rub on pebble beaches near Robson Bight. Beach rubbing has rarely been observed elsewhere. The predictability of whale sightings in these sheltered waters offer unequalled opportunities for research and wildlife viewing of these complex and visually impressive animals. Recently, concerns have arisen that human activities such as whale watching, logging, and commercial fishing potentially threaten continued use of this region by killer whales.

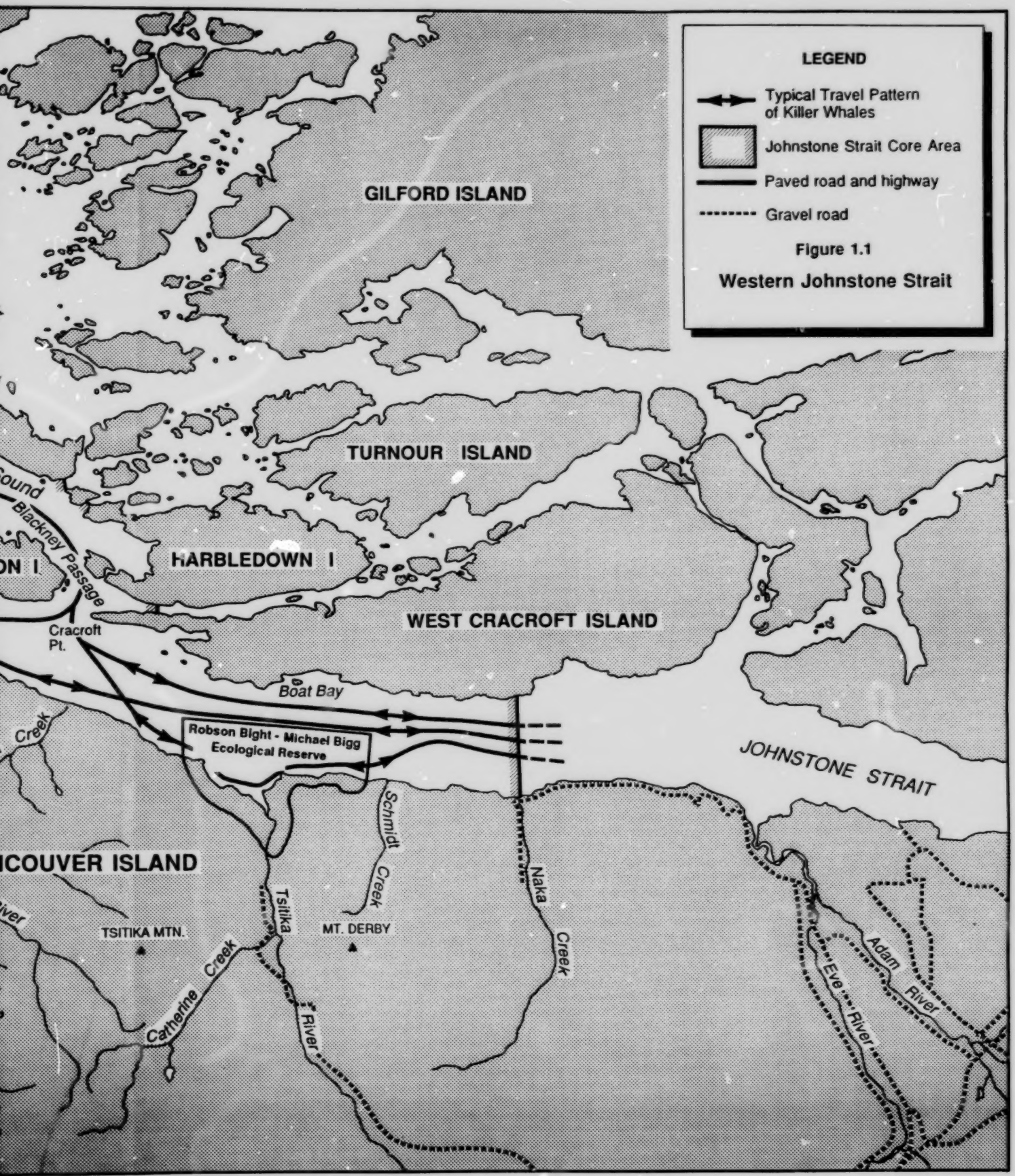
There are many unanswered questions regarding the biological requirements of these whales, such as "How important are Johnstone Strait and Robson Bight in the ecology of this killer whale population?" The position of killer whales at the top of the food chain and their low reproductive rates makes it difficult to detect threats to their existence. Until basic questions regarding their ecology are answered, management of human activities in the region must be conservative to maintain integrity of the whales' environment. If well-managed, negative impacts can be minimized or avoided. Although we do not have all the answers at this time, we have enough information to revise current management practices. As more information becomes available, management can be periodically re-evaluated.

In the past ten years, the unique conservation, scientific and education values of the area have been recognized by the public and the federal and provincial governments. Growing public concern for the protection of killer whale habitat resulted in recommendations by the British Columbia Ministry of Environment to halt development plans for a log handling facility at Robson Bight in 1981. Robson Bight was recommended by Parks Canada as a site of National Significance (Rennie 1982). In 1982, the marine portion of Robson Bight Ecological Reserve was established by the provincial government to protect nine km of shoreline. A land buffer was added by the British Columbia Ministry of Parks in 1988-89, along the entire length of the marine portion and centred around the Tsitika estuary. The protection of ecosystems for long-term research and education is the primary objective in ecological reserves.

In December 1990, the Reserve was renamed the Robson Bight (Michael Bigg) Ecological Reserve (RBMBER) to commemorate the outstanding contribution of the late Dr. M.A. Bigg, to our knowledge of killer whale populations.

Figure 1.1: Johnstone Strait Study Area


0
5
10
Kilometres
QUEEN CHARLOTTE STRAIT
MALCOLM ISLAND
SOINTULA
BROUGHTON STRAIT
Donegal Hd.
Bold Hd.
Blackfish Sound
Weynton Passage
Blackney Passage
HANSON I
ALERT BAY
PORT NcNEILL
River
Nimpkish
Beaver Cove
TELEGRAPH COVE
Cracroft Pt.
BEAVER COVE
KOKISH
19
Kaikash Creek
Kokish
Nimpkish
Lake
VANCOUVER ISLAND
Bonanza River
River
TSITIKA MTN.
Catherine
CORE AREAS OF RESIDENT KILLER WHALES
JOHNSTONE STRAIT
PORT McNEILL
VANCOUVER ISLAND
SAN JUAN IS.
N


LEGEND
Typical Travel Pattern of Killer Whales
Johnstone Strait Core Area
Paved road and highway
Gravel road
Figure 1.1
Western Johnstone Strait
GILFORD ISLAND
TURNOUR ISLAND
Blackney Passage
HARBLEDOWN I
WEST CRACROFT ISLAND
Cracroft Pt.
Boat Bay
Robson Bight - Michael Bigg Ecological Reserve
JOHNSTONE STRAIT
Schmidt Creek
Naka Creek
Tsitika River
TSITIKA MTN.
MT. DERBY
Catherine Creek
Adam River
Eve River

As whales have grown in society's consciousness as a symbol of the environment, we have become more interested in viewing them in the wild. Whale watching in prime areas of whale concentration such as Hawaii, Baja California, southeast Alaska, the Gulf of Maine and the Gulf of St. Lawrence has become a lucrative business. Whale watching is a relatively young industry in Canada, but with a potential economic value comparable to a commercial fishery (Breton 1990).

The exceptional killer whale viewing opportunities in Johnstone Strait and Robson Bight provided the impetus for the development of a whale watching industry beginning in 1981. Killer whales now form the basis of a multi-million dollar tour industry on northern Vancouver Island (Duffus and Dearden 1989). Tours depart from a number of harbours including Port McNeill, Alert Bay, Kelsey Bay, Campbell River, and Vancouver. Growing numbers of recreational boaters, kayakers and commercial film companies also visit the region to see and film whales. Cruiseships and in-transit boat traffic divert their courses for better views of whales. In addition, whale watching is a popular incidental attraction for sportfishermen, who frequently stop fishing to follow the whales when they travel nearby.

In Alaska, Hawaii and Baja California, vessel traffic is suspected to have discouraged humpback and gray whales from using breeding, feeding and calving habitats (Atkins and Swartz 1988). We are concerned that a similar phenomenon will occur in Johnstone Strait. To reduce boat congestion around whales, both the federal and provincial governments have taken measures to inform the public. Both the Department of Fisheries and Oceans and the Ministry of Parks have distributed boating guidelines to whale watchers, such as whale researchers, tour operators, recreational boaters, and photographers. A volunteer warden program under the Ecological Reserves Program has been in place since the establishment of Robson Bight as a reserve. Since 1987, the Ministry of Parks has also sponsored a seasonal information program to educate boaters entering the Reserve.

Forestry and fishing are also important economic activities in the region. Logging roads are currently being constructed south and east of the Reserve which could provide land access to the rubbing beaches and end their protective isolation. Studies are currently underway to determine if any siltation and debris which might be generated from logging operations adjacent to the Reserve could potentially affect sensitive whale habitat at the rubbing beaches. The annual peak of commercial fishing activity takes place in the Reserve when whales are also present in peak numbers. Vessel activity associated with commercial fishing can interfere with the whales' use of the rubbing beaches and resting areas (Briggs 1991). It is important that all uses are managed to minimize disturbance to the whale population.

Given the importance of Johnstone Strait and RBMBER to killer whales, and the value of killer whales in this region to the public, measures are needed to ensure that a suitable environment is maintained for the whales. To that end, the British Columbia Minister of Parks and the federal Minister of the Department of Fisheries and Oceans have jointly appointed this task force, called the Johnstone Strait Killer Whale Committee. The Committee is to propose management options for consideration by the two levels of government. The Committee's ten members have particular expertise to address the broad range of issues regarding management of killer whales in the region. Members' management expertise includes ocean and land habitat, tourism, forestry, native affairs, resource management in ecological reserves, commercial fisheries and whales (Appendix 1).

The mandate of the Committee is:

- to assess the importance of Johnstone Strait and Robson Bight to killer whales;
- to assess the impact of human activities on killer whales and their environment; and
- to suggest management options that will ensure the continued presence of killer whales in Johnstone Strait and at Robson Bight taking human resource uses into account.

The Committee will examine the impact of all human activities on killer whales in Robson Bight (Michael Bigg) Ecological Reserve (RBMBER) and the impact of whale watching activities in other areas of Johnstone Strait. In the report, RBMBER is often treated separately from Johnstone Strait as a whole. This was done for three reasons:

- our knowledge of killer whales in RBMBER is more detailed than in Johnstone Strait;
- RBMBER contains rubbing beaches which are vulnerable and sensitive whale habitat type rarely found elsewhere; and
- current management of RBMBER, as a provincial reserve, is considerably different from the rest of Johnstone Strait, which is wholly within federal jurisdiction.

Options will define management recommendations for implementation by the Department of Fisheries and Oceans and the Ministry of Parks.

2.0 THE STUDY AREA

The areas being examined in the report are:
1. Johnstone Strait, and in particular, western Johnstone Strait (Fig. 1.1); and
2. Robson Bight (Michael Bigg) Ecological Reserve (Fig. 2.1).

The main physical features of these regions are described below.

2.1 Johnstone Strait

Killer whales use western Johnstone Strait more frequently than any other coastal waterway in British Columbia. The Strait lies along a east-west axis and is located off northeastern Vancouver Island between Beaver Cove and Adam River. It is 40 km long by about 4 km wide and bordered to the south by Vancouver Island and to the north by small islands adjacent to mainland British Columbia. On the Vancouver Island side, steep mountainous terrain ascends to 1000 m. The islands on the north side of the Strait, such as West Cracroft and Harbledown, slope more gradually to lower peaks (typically 200 m). The shore drops sharply to the waterline on both sides of the Strait.

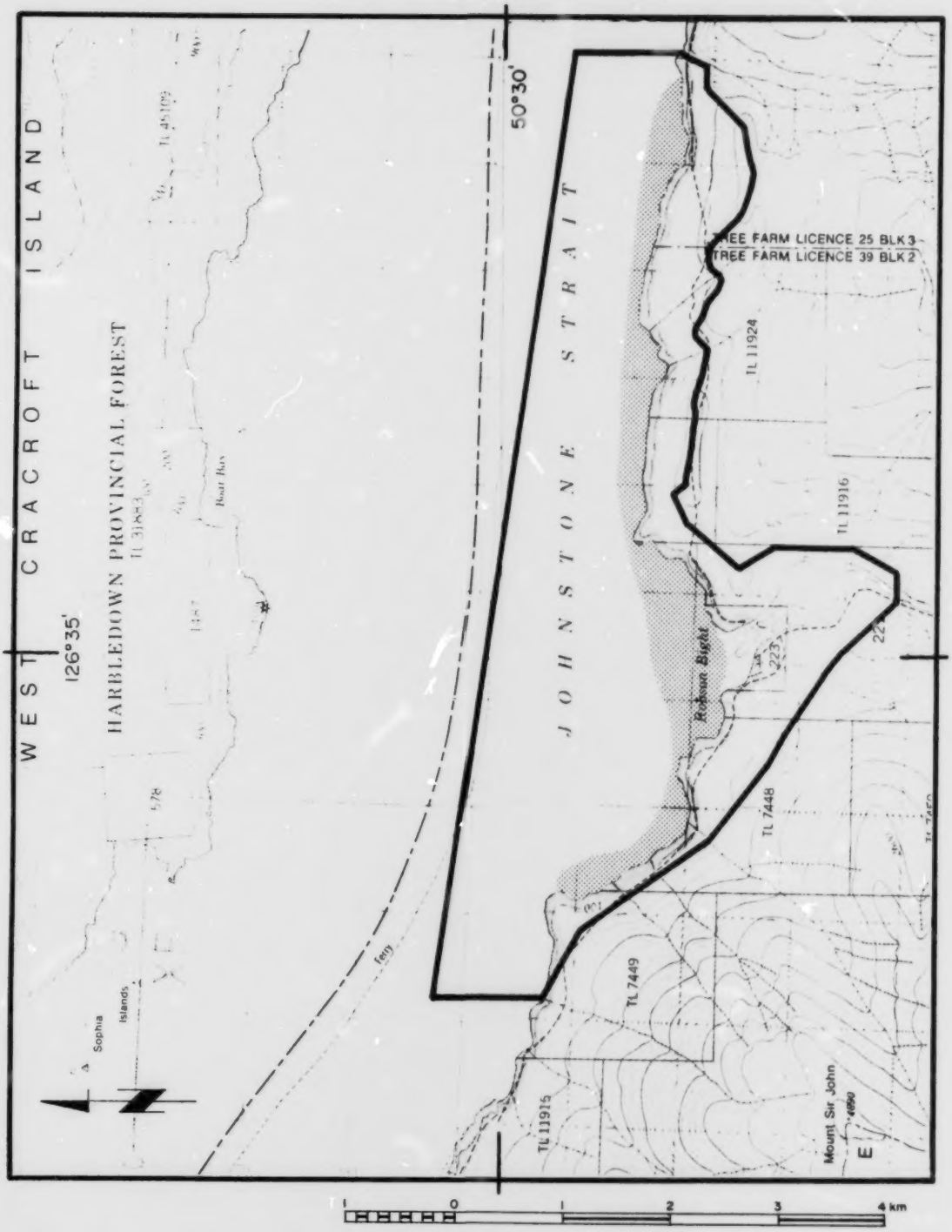
Eastern Johnstone Strait extends an additional 40 km east to Chatham Point and tends to be narrower (2 km), shallower (200 m) and with higher (1500 m) mountainous borders than western Johnstone Strait. Further to the east and northeast are numerous narrow channels which eventually connect with Georgia Strait to the southeast.

Most of the slopes on both sides of the Strait are forested, or in various stages of regrowth following logging. The area is classified under the Coastal Western Hemlock Biogeoclimatic Zone (Ceska 1981). Climate and vegetation are quite different on the north and south sides of the Strait. On the south shore, dominant tree species include western hemlock, amabilis fir, and Sitka spruce (Holmsen Forestry 1985). This reflects the high levels of rain, fog and cloud of the Vancouver Island shoreline. The islands on the north side of the Strait are drier and receive more sunshine in the summer than the islands on the south side. Relatively drought-tolerant species, such as Douglas-fir and shore pine, are common on West Cracroft Island.

Oceanographically, the Strait is characterized by cold waters (7 to 10 degrees Celsius), and high oxygen content. Thompson (1981) partially attributes this to the narrowness of the channel and rapid tidal streams. The water is in almost constant agitation from top to bottom and there is little tendency for stratification thermally or in oxygen content.

Turbulence and mixing of the water column is enhanced by tidal flushing through the narrow passes between Hanson Island, Swanson Island, Malcolm Island, Cormorant Island, and West Cracroft Island. These passes are shallower (typically 100 m) than western Johnstone Strait. Further to the west are the open waters of Queen Charlotte Strait which ultimately join with the Pacific Ocean off northern Vancouver Island.

Figure 2.1 Robson Bight (Michael Bigg Ecological Reserve) (#111), Johnstone Strait, B.C.



2.2 Robson Bight (Michael Bigg) Ecological Reserve[1]

The Robson Bight (Michael Bigg) Ecological Reserve (RBMBER) was established;

- to protect key habitats for killer whales;
- to prevent whale harassment while using these habitats;
- to maintain unique opportunities to research and observe whales; and
- to protect a pristine estuary, shoreline and vegetated slopes.

The Reserve is located in western Johnstone Strait along the Vancouver Island shore (Fig. 2.1). A background report, commissioned by the Ministry of Parks (Blood et al. 1988), describes physical, biotic, and other features of the Reserve. The findings are briefly summarized below.

The Reserve includes marine and terrestrial components and is 1753 hectares in area, centred around the Tsitika River estuary. It stretches along 10.7 km of shoreline from the eastern boundary at Schmidt Creek to the western boundary at Sir John Creek. The marine component is 1248 ha with an outer boundary extending 1.0 to 2.3 km from shore. The land component is 505 hectares and is 200-1500 m wide from the shoreline. Both the land and marine portions are widest around the Tsitika estuary, which drains into Robson Bight. Topography is steep and rocky, except for the flood plain and estuary. The marine portion drops off quickly to 400 m in depth.

---

[1] The Reserve was recently renamed in recognition of the contribution of the late Dr. Michael A. Bigg to our understanding of killer whales. Dr. Bigg, former co-chair of the Johnstone Strait Killer Whale Committee, passed away in October 1990.

3.0 BIOLOGY OF KILLER WHALES

3.1 World

Killer whales inhabit all oceans of the world from the edge of the polar pack ice to the tropics (Heyning and Dahlheim 1988). Throughout this extensive range only one species is recognized, Orcinus orca, characterized by distinctive black and white markings. Adult males can reach 9.8 m in length and 10 tonnes. Females may weigh 7.5 tonnes. In adult males, the dorsal fin reaches 1.8 m compared to 0.9 m in mature females.

The largest concentrations of killer whales seem to occur in the cooler coastal waters of both hemispheres. Although there is no reliable estimate of total world population, the species is not considered abundant. They are opportunistic predators, feeding on a wide variety of fish, squid and marine mammals. Killer whales have no natural enemies, although small numbers have been taken for food or as a predator control measure off Japan, Norway and in the Antarctic. Between 1962 and 1989, approximately 125 whales were taken for aquaria from British Columbia, Washington, Iceland and Japan (Hoyt 1990).

3.2 British Columbia

Coastal British Columbia is unique in having a large concentration of killer whales which can be seen predictably each year in easily accessible, protected waters.

They have been studied extensively in British Columbia since the discovery that each individual can be recognized by unique natural markings. Two races have been identified, called **resident** and **transient** (Bigg et al. 1990). The races differ slightly in appearance of the dorsal fin and saddle patch. Although their ranges overlap, the two races do not appear to mix. Many behavioural differences exist as well. For example, residents feed almost exclusively upon fish whereas transients feed upon marine mammals. Residents predictably visit the inshore areas during summer whereas transients occur irregularly at any time of the year.

Killer whales are long-lived and slow to reproduce. Long-term population studies indicate that potential life spans for residents are 80-90 years for females and 50-60 years for males (Olesiuk et al. 1990). By age 40, cows have produced an average of 5 viable offspring and calving generally ceases after this. Calving season spans October-March. Based on gestation periods, mating occurs primarily during May-October (ibid.).

Residents typically travel in groups of 10-20 while transients travel in groups rarely exceeding five individuals. Residents use 'core areas' seasonally in Haro Strait off southern Vancouver Island and in Johnstone Strait off northern Vancouver Island. Transients do not appear to use 'core areas' and do not use rubbing beaches. Many of these racial differences may have developed from hunting two distinct types of prey.

The biology of residents is understood more completely than that of transients, although virtually all individuals have been identified and named[2]. Residents travel in family groups called **pods**. A pod is composed of one or more adult females and their offspring and can contain up to four generations. Individuals travel with their closest relatives in their pod all of their lives (Bigg et. al. 1990). A new pod forms by the gradual splitting of an existing pod along maternal lines. Each pod has its own dialect of 7-17 stereotyped calls (Ford 1989). Residents frequently vocalize, probably using their calls to coordinate group movements and social interactions.

Of the 19 resident pods in British Columbia, 16 pods totalling 190 whales (1989 census) comprise a **northern community**. This northern community ranges along 700 km from the east and west coasts of Vancouver Island to the southern Alaska panhandle. The remaining 3 pods, totalling over 85 whales, form a **southern community** which ranges 550 km from Campbell River south to the west coast of Washington. Resident community ranges are shown in Figure 3.1. Both communities likely spend most of their time in offshore areas, perhaps within a few hundred kilometres of the British Columbia coast. The pods of both communities enter inshore waters most frequently during May-October. During this time, the whales feed extensively upon salmon which are migrating to rivers for spawning.

The northern community has grown at an average annual rate of 3.0% between 1973 and 1988, and probably at a similar rate since 1955 (Olesiuk et al. 1990). While the net rate of increase appears small, it is a high rate for such a long-lived species. The southern community has increased at a rate of 1.5% between 1974 and 1988 (ibid.). Over 35 whales in the southern community, many of which would now be of reproductive age, were captured for zoos and aquaria between 1962 and 1977 (ibid.). A small number (14-15) were also taken from the northern community (ibid.).

Reasons for the population increase in the northern community could be:

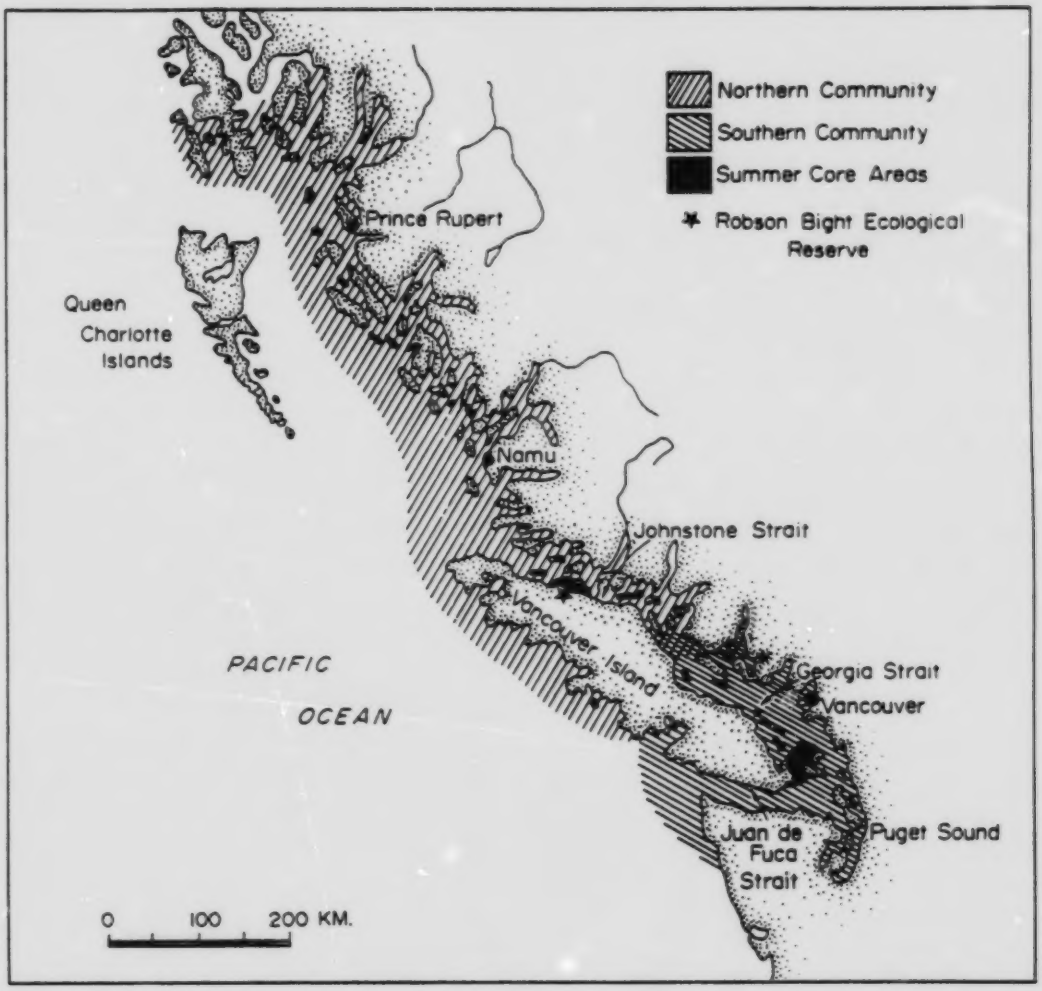
1) recovery from losses due to shooting and harassment by federal fisheries personnel, fishermen and the public prior to the mid 1960's and from military bombing during World War II (Olesiuk et al. 1990);
2) an improved natural environment such as increased food supply; and/or
3) a long-term natural cycling of the population with the current phase increasing.

At some point, the northern residents' high rate of population increase is likely to level off. We do not know how this will affect behaviours or pod associations.

---

[2] All individuals are named using an alphanumeric designation, the prefix denoting the pod or pod complex, and the numeric denoting the individual. Numbers were assigned in the order they were first sighted. For example, B6 is a member of the B pod, and was the sixth animal to be identified in that pod. For a full description of the identification system, see Bigg et al. 1987. Killer Whales: A Study of Their Identification, Genealogy & Natural History in British Columbia and Washington State.

Figure 3.1 Resident killer whale ranges in British Columbia.



Transients also travel in groups composed of close relatives, although offspring disperse more than in resident pods (Bigg et al. 1987). About 100 transients in 45 groups comprise one community (ibid.) with a single dialect (Ford 1989). Transients have a large range, along 1800 km of the coast from southern Washington to Glacier Bay, Alaska. Although the transient range overlaps those of the two resident communities, they tend to utilize it differently (Bigg et al. 1987). For example, transients tend to frequent shallow bays and inlets more often than residents.

3.3 Western Johnstone Strait

Although whale sightings along the British Columbia coast are reasonably frequent, western Johnstone Strait is unique because killer whales use the area so predictably. During summer, the northern resident whales enter western Johnstone Strait from Queen Charlotte Strait through narrow channels between the islands west of the Strait (Fig. 1.1). They usually travel back and forth between approximately Adam River and the northwest side of Hanson Island for several days. Whales often exit west to Queen Charlotte Strait. Alternately, they travel east toward Campbell River and Jervis Inlet before returning.

Although killer whales are seen or heard[3] in Johnstone Strait throughout the year, sightings of whales become more frequent in mid-June and by early July, increase sharply (Fig. 3.2). Nichol (1990) compiled sightings as **whale-days** (one whale-day equals one whale present on one day). Sightings peak during August and average 30-40 sightings per day. Occasionally, they congregate in Johnstone Strait in concentrations of 50-100 whales ("superpods"). Resident whales were seen on 86% of 486 total observation days during July-September 1980-86 (ibid.).

Johnstone Strait is the first physical constriction that killer whales and migrating salmon encounter as they return from the open Pacific. Here, the whales feed on chinook, sockeye, chum, pink and coho salmon returning to spawn in coastal streams and rivers (Bigg et al. 1990).

All northern resident pods usually visit Johnstone Strait each year. Some are seen in Johnstone Strait more consistently from year to year than others (Fig. 3.3). For example, the most frequently sighted pods, A1 and A5, were recorded on more than 80% and 50% of the observation days respectively. Only 5 of the 16 pods were seen more than 20% of the time.

---

[3] Killer whales are also identified from acoustic data gathered by a network of hydrophones (underwater microphones) operating in Johnstone Strait and have been seen or heard in the core area throughout December 1990 and January 1991 (Mackay, pers. comm). The difficulty of conducting research in the winter months has likely affected the frequency of winter sightings.

Figure 3.2. **Mean number of whales in Johnstone Strait per month estimated from sightings and acoustic data, 1980-86** (after Nichol 1990). One whale-day equals one whale present on one day.

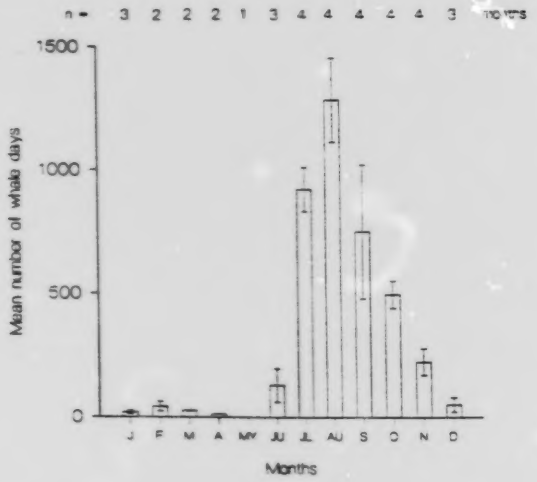
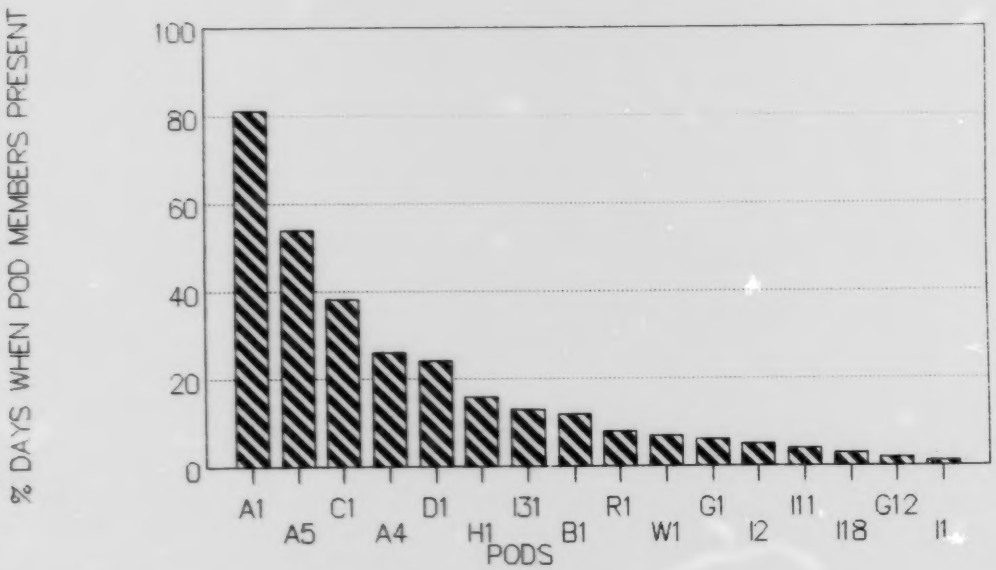
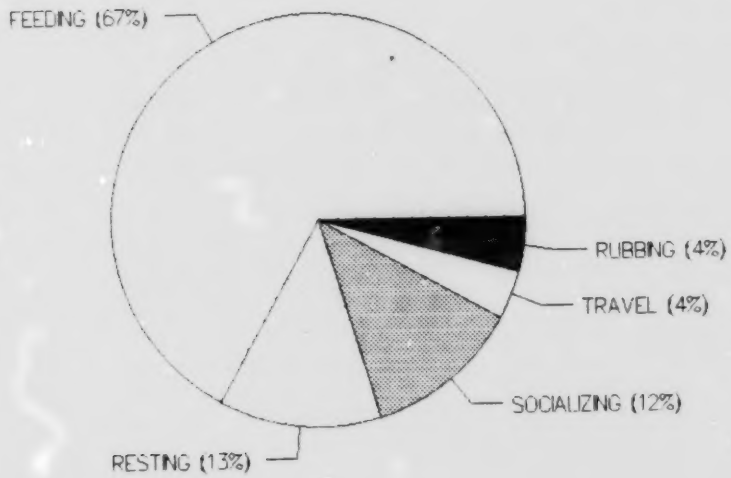


Figure 3.3. **Frequency of occurrence of all or part of each northern resident pod in Johnstone Strait during July-September 1984-88** (after Nichol 1990)



Ford (1984) divided the behaviour of northern residents in western Johnstone Strait and adjacent areas into five categories: foraging, resting, socializing, travelling, and beach rubbing (Fig. 3.4). Foraging is undertaken by individuals and small groups,and is typified by active swimming and diving. Resting whales synchronize breathing while stationary or during slow swimming. Socializing includes physical interactions such as jumping, play and sexual activity. Travelling whales swim typically at speeds of 4-12 knots. Except for beach rubbing, which is described in section 3.4, all behaviours are seen throughout western Johnstone Strait.

Figure 3.4. Behaviour time budget of northern resident killer whales in Johnstone Strait, British Columbia. (from Ford 1984)



Transient killer whales are seen occasionally in western Johnstone Strait throughout the year. These whales tend only to travel and forage in the area, and do not linger in the region as do the residents.

3.4 Robson Bight (Michael Bigg) Ecological Reserve (#111)

Resident killer whales entering western Johnstone Strait are also likely to visit RBMBER. Over 90% of the whales entering the Strait in 1987 and 1989 also frequented the rubbing beaches (Briggs 1991). More than 20% of total time in the Strait was spent in the Reserve, with time divided almost equally between the rubbing beaches, the Bight and the remainder of the Reserve (Briggs, in prep.). The strong correlation between killer whale visits to western Johnstone Strait and beach rubbing suggests that it may be partially responsible for the predictable travel pattern of whales in the core area. Beach rubbing is not encountered frequently outside of the Reserve because suitable rubbing sites are rare in the region. Rubbing behaviour is interspersed primarily with resting. Residents often feed on salmon that congregate along the bluffs and deep waters of Robson Bight.

Rubbing has also been recently observed in another population of killer whales in Alaska (Balcomb-Bartok1990). No beach rubbing has been reported for the southern resident community of killer whales.

Rubbing whales swim slowly back and forth over pebbly barnacle-free beaches, with their flanks, bellies or sides gently touching the pebbles. Ford (1984) reported average rubbing sessions of 35 minutes, although pods might rub for 90 minutes. Briggs (1991) reported that whales would rub an average of 6 to 12 minutes/day in 1987 and 1989, but would rub as long as four hours. The reason for beach rubbing is unknown but it may be to remove skin parasites, for pleasure and for socializing. Killer whale skin is very delicate, and rubbing whales appear to exercise considerable caution when in physical contact with the substrate.

When rubbing, the whales can be easily disturbed by human activity in the vicinity. Briggs (1991) found that vessel movements within 300 m of the beaches and the presence of humans on shore often caused avoidance behaviours by the whales. This is discussed further under Short-term Responses of Killer Whales (Section 6.1).

Transients occasionally pass through the RBMBER, but they do not beach rub, forage or rest in the area.

3.5 Overview of killer whale biology

Killer whales are among the most studied marine mammals in the world and more is known about the 400+ individuals along the British Columbia coast than any other killer whale population. There are two races, 1) marine mammal hunters (transients) and 2) fish eaters (residents) which differ in many other aspects besides diet. Residents' predictable occurrence, relative accessibility, stable family groupings and individual recognizability have allowed researchers to determine maximum age (50-75 years), reproductive rate (1.5-3.0%), range and exact population size.

Currently, there are over 190 whales in a distinct northern resident population, some of which frequent Johnstone Strait on an almost daily basis during the summer. While these whales are attracted here to feed on migrating salmon, they also rest, socialize and rub on certain pebble beaches in the area. The most frequently used beaches are protected within RBMBER, where whales have been observed to rub for hours at a time if left undisturbed.

Although a great deal is known about resident killer whales, especially compared to killer whale populations elsewhere in the world, there are still many important ecological questions to be answered regarding the importance of Johnstone Strait in their life history, especially to individual pods; and responses to changes in their environment. For example, we do not know where the northern resident population of killer whales spends the remainder of the year and how important the Johnstone Strait area is to their survival. Nor do we know what special role the Robson Bight area may play in the social behaviour of these animals and possibly in their continued presence in Johnstone Strait. Until these questions are answered, resource management must be cautious and conservative where it may affect them.

4.0 REGIONAL OVERVIEW OF HUMAN ACTIVITIES

The following is a general overview of human activities in western Johnstone Strait and adjacent areas. Resource use in and around Johnstone Strait generally involves forestry, fishing, tourism or transportation. Descriptions of resource activities in the vicinity of Robson Bight are also presented in Darling (1986) and Blood et al. (1988).

Chapter 5.0 deals with the potential for these activities to lead to disturbance of killer whale habitat or behaviour.

4.1 Communities of northern Vancouver Island

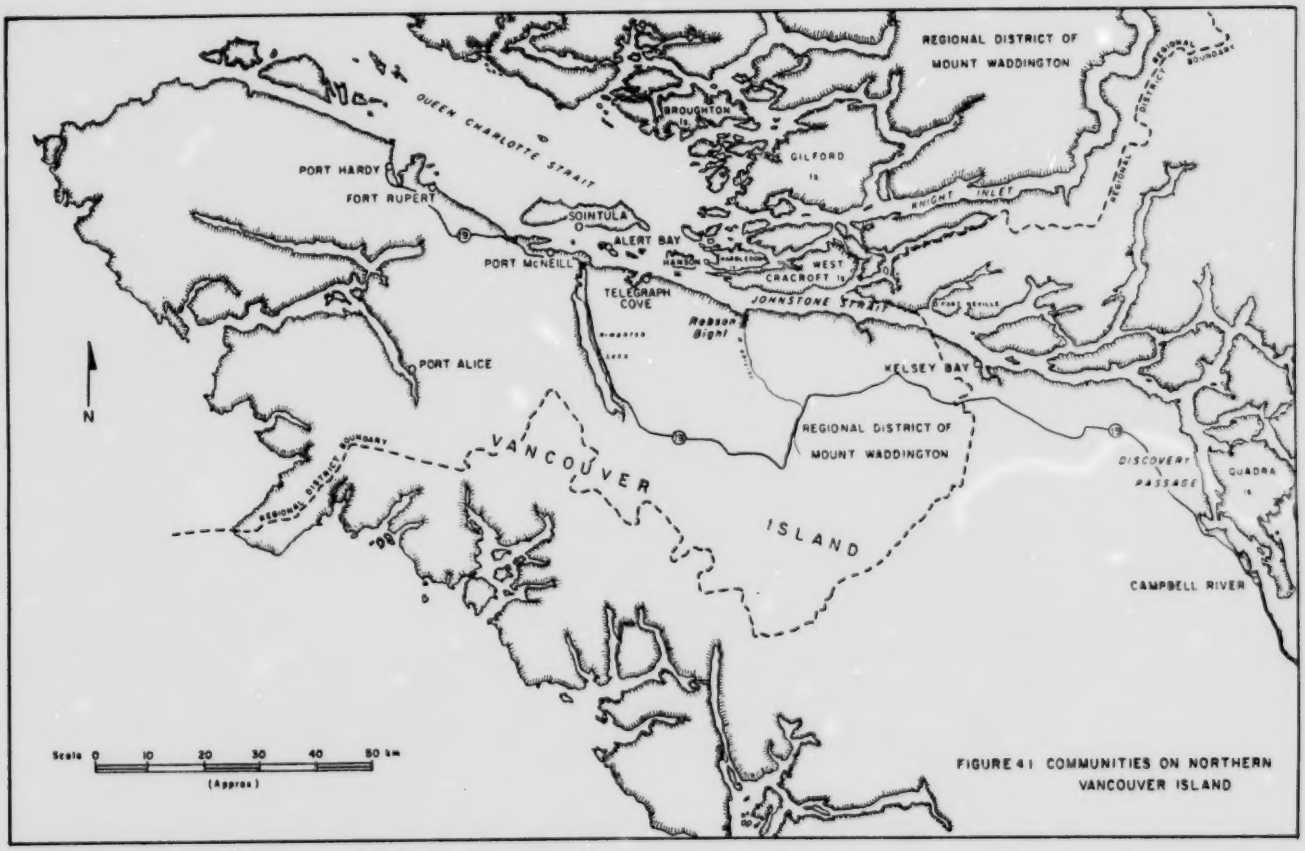
Western Johnstone Strait and adjacent areas lie within the Regional District of Mount Waddington. The following demographic information is based primarily on Fig. 4.1 and Table 4.1.

Approximately 14,500 people live in the District, primarily in the communities of Port Hardy, Port McNeill, Alert Bay, Sointula, and Port Alice. Populations of communities are shown in Table 4.1. The District population peaked in 1986 at almost 15,000 people. Telegraph Cove, the nearest community to Robson Bight, has a permanent population of less than 20. There are also small communities or logging camps at Port Neville, Adam River, and Beaver Cove. The public highway system linking Campbell River and Port Hardy was completed in 1979. Employment and education opportunities are limited, contributing to a net outflow of residents since 1986.

Table 4.1 British Columbia Population Estimates for Mount Waddington Regional District (MWRD) (Sources: Statistics Canada, 1986; MWRD)

Name	Census 1986	Estimate 1988
MOUNT WADDINGTON	14,934	14,495
Alert Bay	679	680
Port Alice	1,387	1,360
Port Hardy	5,389	4,945
Port McNeill	2,559	2,455
Sointula		~1,000
Indian reserves	1,392	-

Figure 4.1 Communities on northern Vancouver Island.



Primary industries of the North Island continue to be forestry, fishing, and mining, the traditional resource-based economies of the area. These industries accounted for almost 4,000 direct and indirect jobs in the Regional District in 1989 (Mossop 1989). The Island Copper Mine near Port Hardy is a major employer in the Region, although it is scheduled to close in 1996 (Harvey, in press). Two rapidly growing sectors of the economy in 1989 were tourism and aquaculture. Tourism directly employed at least 370 full-time and 400 part-time people in 1988 in the Mount Waddington Regional District (Mossop 1989). This industry has shown dramatic expansion in the past few years (ibid.) Direct employment in aquaculture in 1988 included 68 full-time and 33 seasonal jobs (Mossop 1989).

Approximately 1,392 Natives resided on northern Vancouver Island in 1986 (Statistics Canada, 1986). Alert Bay is the largest Native community in the Johnstone Strait area. Approximately 90% of the village's men are employed seasonally in fishing and 70% of the women are employed in administration (Ambers, pers. comm.). Other sources of employment are logging, salmonid enhancement projects and tourism.

4.2 Coastal Tourism / Whale Watching

Johnstone Strait is part of the sheltered navigation corridor known as "the Inside Passage". This waterway is used by pleasure craft to explore the fjords and inlets of British Columbia for outdoor recreation, and as a scenic and safe route to Alaska. Completion of the highway from Campbell River to Port Hardy in 1979 has made northern Vancouver Island and Johnstone Strait more accessible. In 1988, more than 270,000 tourists visited the north Island. The majority of visitors are in transit to the Port Hardy - Prince Rupert ferry. Tourist activity peaks from July through September and visitors participate in fishing, camping, sightseeing, boating and whale watching/nature tours (Table 4.2). With scheduled completion of the new Island Highway in 1996, access between Nanaimo and Campbell River will become freeway-standard and is expected to further stimulate tourism activity on the North Island.

Two private campground resorts, Alder Bay (64 campsites) and Telegraph Cove (120 campsites) are located in areas directly accessible to Johnstone Strait. The Regional District also operates a campground in Port McNeill, which is easily accessible to a boat launch and marina.

Mossop (1989) reported rapid growth for all charter business, including whale watching, on the north Island in 1988-89. Tourboat operations offering whale watching, located at Telegraph Cove, Port McNeill, Sointula, Kelsey Bay and Vancouver, have increased from 1 in 1980 to 27 in 1990. However, only three of these operate full-time as whale watching charters and these carry the majority of the passengers. Of an estimated 25,000 people who went whale-watching on B.C. charter vessels in 1989 (Duffus and Dearden 1990), 10,000 visits were to Johnstone Strait (Duffus, pers. comm.). This estimate includes motor vessel and sailboat passengers and kayak tours. In 1990, one tour company reported a 19% increase in visitation over previous years (Mackay, pers. comm.).

Table 4.2 Selected Visitor Activities on northeast Vancouver Island in 1988. (Source: Mossop 1989, except where noted)

Activity	Visitors
Cruiseships in Port Hardy	11,800
Freshwater fishing	92,000*
Saltwater fishing	108,800*
At fishing lodges	9,500
Camping	40,800
Whale watching**	8,000
TOTAL	270,900

* Angler-days
** MacKay, pers. comm., 1991

Major attractions of nature tours are viewing killer whales and experiencing natural areas. Duffus and Dearden (1990) found that experience of the environment/ scenery/other wildlife added most to the whale watching event. Conversely, visibility of logging activity in Johnstone Strait was a major detraction from the recreation experience. From a tourism marketing perspective, killer whales are an important 'top of mind' image, especially for adventure travel but also more generally in experiencing 'SuperNatural BC' (Bekker, pers. comm.). Such images are the visual 'hook' in attracting visitors from around the world.

Recreational boaters include those who have come specifically to Johntone Strait to see whales, boats passing through and those who are in the area primarily to sportfish. From 1984-87, recreational vessels in the Strait increased from 6% to 18% of all traffic (Blood et al. 1988).

Johnstone Strait is a popular destination for organized kayak tours and private trips. The kayaking season extends from June through October and peaks in July and August. In 1990, kayak launchings from Telegraph Cove were estimated at 1,400 - 2,000. Ocean kayaking in western United States is one of the fastest growing outdoor activities (Interagency Committee for Outdoor Recreation 1990). Much of this activity will likely take place in British Columbia because this sheltered coastline offers more opportunities for kayaking than the Pacific states (Osborn, pers. comm.).

Cruiseships and ferries in transit between southern British Columbia and Alaska occasionally stop or detour to view killer whales in Johnstone Strait. There were at least 19 cruiseships making regular trips between Vancouver/Victoria and Alaska in 1990 (Vancouver Port Corporation 1990). An additional three ships are being added to the B.C. - Alaska route in 1991, for a total of 238 cruiseship calls in Vancouver enroute to/from Alaska (Daniels, 1991). The Alaska State ferries transit Johnstone Strait twice a week year-round (Alaska Marine Highway 1990).

Spectacular underwater life and excellent winter visibility have made this area a renowned diving destination. Reefs around the small islands at the western approaches to Johnstone Strait are popular dive spots.

4.3 Other Marine-based Activities

4.3.1 Fishing

Commercial Fishing

Salmon is the predominant catch of the commercial fishing fleet in this area. A small number of boats commercially fish for rockcod, lingcod, red snapper and invertebrates such as prawns, primarily in the western entrances to Johnstone Strait.

Commercial salmon fishing takes place throughout the Strait, primarily between July and October. Statistical Areas 12 and 13 (Johnstone Strait) accounted for an estimated 11,500 tonnes of salmon harvested in 1989 or approximately 13% of the British Columbia commercial salmon catch by weight (Department of Fisheries and Oceans 1990) (Appendix 2). An average of 1840 fishing vessels operated in Areas 12 and 13 from 1982-89 and many are local. In 1988, there were 231 licenced commercial vessels from Port Hardy, Port McNeill, Alert Bay, and Sointula (Mossop 1989). The experienced labour force in these communities includes 380-700 commercial fishermen (Statistics Canada 1986; Mossop 1989).

Seiners, gillnetters and **trollers** are the most common fishing gear types used in Johnstone Strait. Seine boats are generally 15-20 m vessels using a net which draws up like a purse around a school of fish. In order to catch salmon which tend to migrate along shorelines, seiners often make beach 'sets', tying one end of the net to a point on land and then pursing the net. Killer whales will sometimes take advantage of this ready-made concentration of fish, eating salmon until the net is almost closed. Gillnetters are generally 10 m boats using a fine mesh net which 'gills' salmon trying to swim through it. Killer whales rarely fail to detect these nets. Trollers use hooks, bait and weighted lines.

Native Fishing

Native-owned boats in the area include 35-40 vessels based primarily in Alert Bay, Port Hardy and Fort Rupert (Cranmer, pers. comm.). Other native communities nearby such as Gilford, Turnour Island, Hopetown, and Kingcome Village have a few boats (Ambers, pers. comm.; Cranmer, pers. comm.).

Sportfishing

The sportfishery is a major attraction for visitors to north Vancouver Island, and growth in guided fishing and charters reflects this. In 1987, there were eight lodges located within range of western Johnstone Strait; there are now approximately 18 (Regional District of Mount Waddington 1990). Guests at fishing resorts increased from 7,989 in 1987 to 9,415 in 1988, a rise of 18.5% (Mossop 1989). A number of the fishing charter/resorts also advertise guided killer whale watching.

4.3.2 Whale Research and Photography

Johnstone Strait is a unique area to observe and research killer whales. There are few other areas in the world where large concentrations of killer whales can be seen so reliably. Johnstone Strait has the additional advantages of sheltered waters and reasonable accessibility by boat. Research is carried out either from small motorized boats, from shore-based observation stations, or both.

The long-term studies conducted in Johnstone Strait have yielded the most significant information about killer whale populations in the world. Research on killer whales in western Johnstone Strait began in 1970 and has continued to the present. The number of research projects, many originating from the United States, grew from several in 1970 to a peak of 13 in 1987 (Taylor 1988a). More research permits have been approved for Robson Bight than for any other ecological reserve in British Columbia. In 1990, research effort had decreased to four teams from the 1987 peak, primarily due to lack of funding.

The detailed research findings regarding population biology and behaviour have largely been possible through cataloguing of individually recognizable whales (Bigg et al. 1987). Researchers have examined abundance, population dynamics, reproduction, seasonal movements, feeding habits, vocalizations, social organization, beach rubbing and numerous other aspects of behaviour as well as studies on the interactions between people and killer whales (Appendix 3). The continuance of research is critical to effective management of killer whales and human impacts on their behaviour and habitat.

The physical and biological conditions which fostered research in this area have also attracted photographers and film crews. Since the early 1970's, professional photographers, television news and documentary crews and cinematographers from around the world have come to western Johnstone Strait to film killer whales. Filming is usually accomplished by following whales in boats, but may also be conducted from land, air and underwater. Filming in the Reserve has been generally controlled under the Ecological Reserve permit program. No photography permits have been issued since 1988 to minimize disturbance to the whales in the Reserve.

4.3.3 Other marine traffic

Western Johnstone Strait is the primary route for merchant ships and other traffic that sail the Inside Passage. The Canadian Coast Guard Vessel Traffic Services estimates that Johnstone Strait is the busiest waterway on the British Columbia coast. Merchant traffic includes tugs with barges, freighters, small oil tankers and other commercial vessels. The Canadian Coast Guard, Department of Fisheries and Oceans and RCMP vessels regularly patrol the Strait. During winter storms, headlands located on either side of Robson Bight provide shelter to tugs with booms and other traffic (Balfe, pers. comm.).

4.4 Forestry

Forestry activity along Johnstone Strait consists of timber access, harvesting, silviculture and sorting and transporting logs by road, rail or water to other locations for processing. Road construction and harvesting occur primarily during spring, summer and fall. The major forestry companies operating in the area are MacMillan Bloedel Ltd., Canadian Forest Products Ltd., Western Forest Products Ltd., Fletcher Challenge Ltd. and International Forest Products.

The forestry sector employed 2858 people in 1989 in the Mount Waddington Regional District (Mossop 1989). The District accounts for 8% of the provincial timber harvest (Association of B.C. Professional Foresters 1987). Wood harvested is either processed in the Region as pulp or transported to mills on the southern Vancouver Island and the Lower Mainland.

4.4.1 Current Logging and Access Activity

Logging, either by hand, A-frame, or clearcut, has taken place along Johnstone Strait since the late 1800's. Harvested areas are in many stages of regeneration but most regrowth is between 10 and 30 years old. During the past 10 years, road construction and/or logging has taken place on West Cracroft Island, Hanson Island and on Vancouver Island.

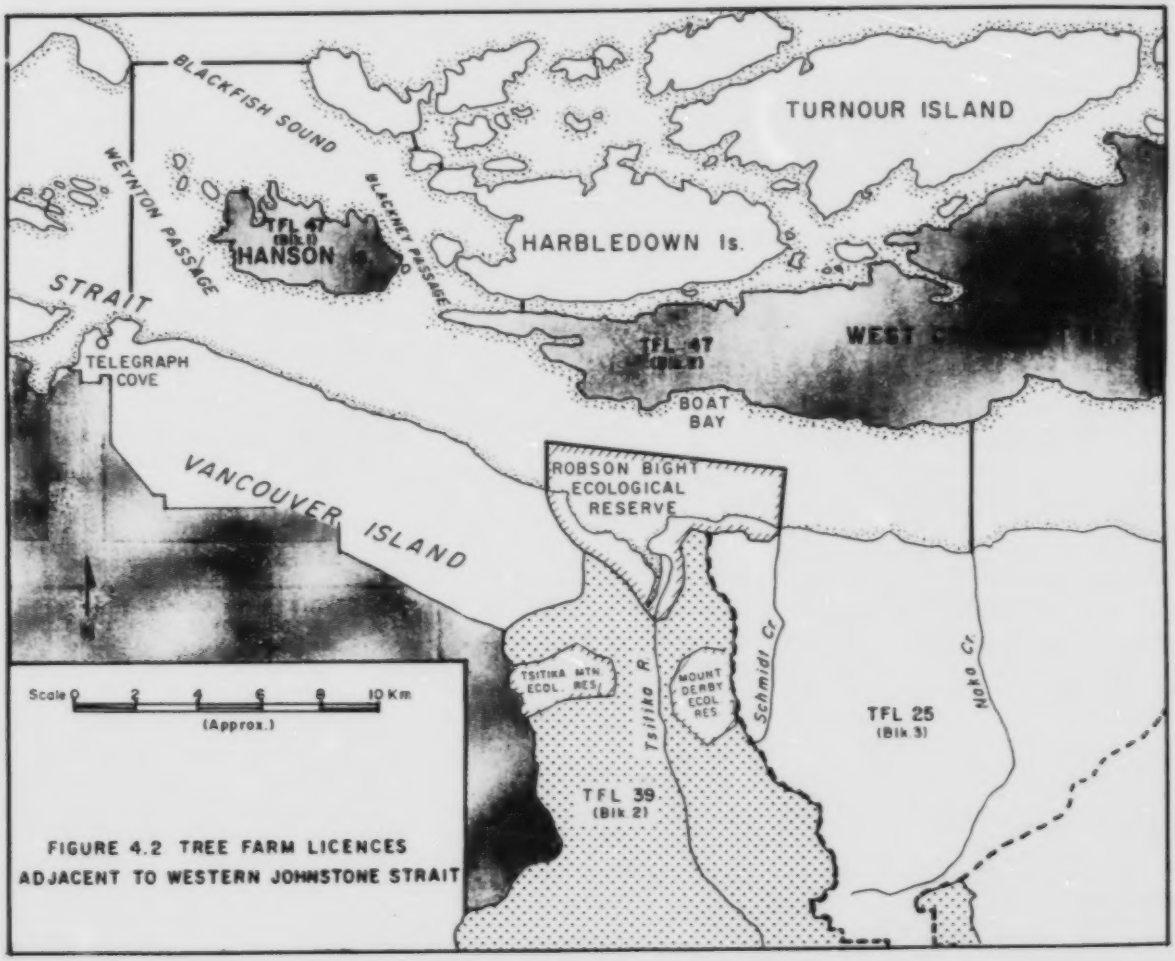
Portions of tree farm licences #25 (Western Forest Products) and #39 (McMillan Bloedel) are adjacent to RBMBER (Figure 4.2). Interfor, Fletcher Challenge (TFL #47) and Canadian Forest Products also have timber rights on the Vancouver Island shore, although these are not directly adjacent to the Reserve. A portion of the shoreline west of the Reserve is not currently within a tree farm licence. Holdings within the Tsitika watershed are subject to an integrated resource plan approved in 1978. Since that time, approximately 10% (3,500 ha) of the 40,000 ha watershed has been harvested, with about 240 km of road constructed (Department of Fisheries and Oceans 1990). Many areas within the Tsitika watershed are protected as critical winter range for wildlife, or as ecological reserves (six areas). Forest harvesting has proceeded to within 4 km of the estuary; access will not be constructed below this point until the Johnstone Strait Killer Whale Committee has concluded its deliberations (Brownlee, Tsitika Follow-up Comm., pers. comm). A gate was installed at Catherine Creek to limit public access to the lower Tsitika watershed.

A 6 km access route was constructed in 1987 along Johnstone Strait from Naka Creek to Schmidt/Peel Creek, providing access immediately east of the Reserve, close to the rubbing beaches. A gate installed 6 km east of Naka Creek in September 1990 restricts public access to the east end of RBMBER.

4.4.2 Forest Management and Planning

The Tsitika Follow-up Committee was established in 1978 to oversee the implementation of the Tsitika Watershed Integrated Resources Plan (Ministry of Forests 1990). Since that time, 12 studies have been conducted in the watershed by various agencies (Appendix 4). In addition, two studies of sedimentation affecting freshwater and marine portions of the Reserve have been commissioned by the Tsitika Follow-up Committee. The marine study examines sedimentation and littoral drift from the Tsitika River and Schmidt/Peel Creek and potential effects on the rubbing beach environment (McConnell, pers. comm.). A long-term sediment monitoring program has been initiated for the Tsitika River by the Ministry of Forests. Sediment levels will be monitored at several locations on the Tsitika mainstem, including the river mouth (Hogan, pers. comm.). Public meetings were held in November 1990 in Vancouver, Victoria, Nanaimo, Campbell River and Port McNeill to determine the public response to the implementation of the resource plan. The Tsitika Follow-up Committee is currently reviewing that input with a view to altering the Tsitika plan to reflect public opinion.

Figure 4.2 **Tree Farm Licences Adjacent to Western Johnstone Strait**
(Source: Ministry of Forests n.d.)



MacMillan Bloedel's current five year plan for the lower Tsitika Valley includes four cutblocks and construction of 9 km of main haul road (EARP 1990):

Cutblock #101 (27 ha) 1990-91
Cutblock #102 (38 ha) 1991-92
Cutblock #103 (34 ha) 1992-93
Cutblock #104 (34 ha) 1994

Timing and location of these cutblocks and road construction are shown in Figure 4.3. Harvesting was approved for Cutblock #101 in 1990, felling has been completed and yarding is underway. Harvesting of the remaining cutblocks has not been approved by the Tsitika Follow-up Committee.

Western Forest Products is the licencee for TFL #25 which includes Schmidt/Peel Creek and a portion of the Tsitika drainage. Harvesting has been completed in Cutblocks #41 and #48 in the Schmidt/Peel Creek drainage (Fig. 4.3). Three other cutblocks are proposed in the current 5 year plan:

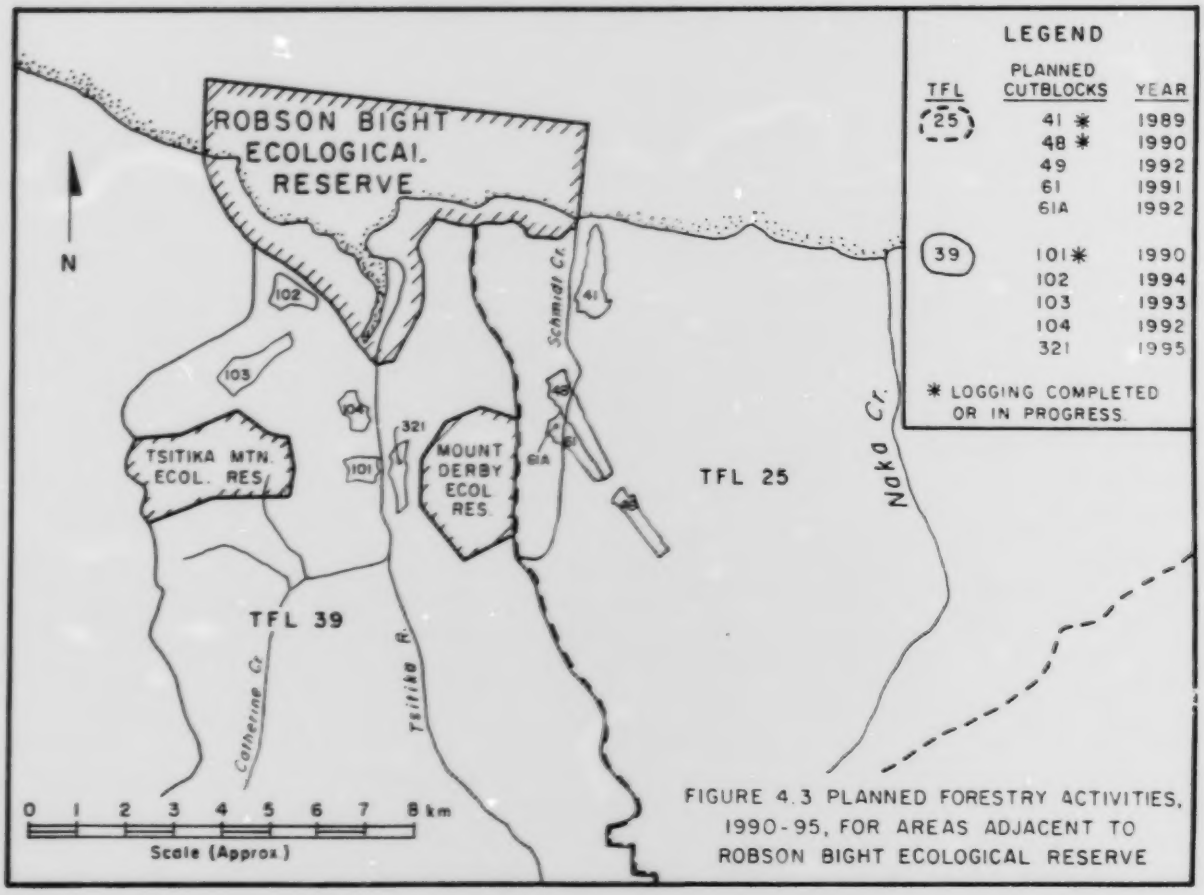
Cutblock #61 (86 ha) 1991-92
Cutblock #49 (70 ha) 1992-93
Cutblock #64 (92 ha) 1994 (deferred indefinitely)

An Environmental Assessment Review Panel (EARP) screening of the Tsitika Watershed Integrated Resource Plan was completed in 1990. The report concluded that no logging or road construction in the lower Tsitika should proceed past Block 101 until:

- the Johnstone Strait Killer Whale Committee and the Tsitika Follow-up Committee have produced their reports and the public has reviewed and commented on these reports;
- the reports on visual impacts and public access have been completed and the public has reviewed and commented on these reports;
- discussions have been held between the Tlowitsis-Mumtagila band, MacMillan Bloedel and the Provincial Government; and
- the study on sediment generation has been completed.

The screening report recommended that the project should be screened again under EARP on completion of the above.

Figure 4.3 **Planned forestry activities, 1990-1995 for areas adjacent to Robson Bight (Michael Bigg) Ecological Reserve.** (Sources: MacMillan Bloedel, 1990; Western Forest Products 1990; Ministry of Forests 1991)



4.4.3 Log Handling

Dryland log sorting areas operate east of the study area at Adam River (MacMillan Bloedel) and to the west at Beaver Cove (Canfor). Canfor also operates log booming grounds at Beaver Cove. Fletcher-Challenge Ltd. operates log booming grounds at Beaver Cove and has constructed a dryland sort on Hanson Island. A dryland sort was proposed for Robson Bight, but plans were cancelled in 1981.

4.4.4 Visual Analysis

Concerns have been raised by the public regarding the potential alterations to the Vancouver Island shoreline, including the Robson Bight landscape, as a result of logging. The public has equated visual alterations of this landscape to loss of physical integrity of killer whale habitat, although there is no indication that this is the case. Perception studies, including a survey of visitors to Robson Bight (Duffus and Dearden 1990) show that unaltered landscapes are significantly preferred over those showing highly visible alterations. Vancouver Island, due to its relatively steep terrain immediately adjacent to the Strait, is more sensitive to landscape alterations than the islands on the north side of the Strait. Prior to any logging that would be visible from western Johnstone Strait, forest companies now use computer modelling to analyze the visual effect of different shapes and locations of cutblocks.

Recent logging visible from the Strait has occurred in the Eve River, Naka Creek, Schmidt Creek and Kaikash Creek drainages, and at Telegraph Cove. West of the Tsitika watershed, only one cutblock is planned for harvest in the next five years (Ministry of Forests 1991). This block, under Fletcher-Challenge T.F.L. #47, would not be visible from Johnstone Strait. International Forest Products also holds timber rights west of the Tsitika but no harvesting is planned here for the next five years (ibid.)

Evidence of logging in the Tsitika watershed, including the recently harvested Block #101, is not visible from Johnstone Strait. According to analyses completed by MacMillan Bloedel and the Ministry of Forests, Cutblocks #102, #103 and #104 in the lower Tsitika drainage would be partially visible from the Strait.

Within TFL #25, clearcuts are highly visible to the waterline immediately to the east of the Reserve. Western Forest Products reports for its five-year plan that:

- Cutblock #61 - 1991-92 - 100% visible
- Cutblock #49 - 1992-93 - < 5% visible
- Cutblock #64 - 1994 - deferred indefinitely

4.5 Traditional Native Use and Land Claims

Johnstone Strait and the islands to the north are within the traditional territory of the Kwakiutl people. Names given to specific sites along Johnstone Strait indicate their use for bark and wood harvesting, clamming, berrypicking and fishing (Boas 1909). There is archeological and ethnographic evidence for use and occupation of Johnstone Strait and Robson Bight by four Kwakwala-speakingtribes: the Matilpi, the Tlowitsis, the Nimpkish, and the Fort Rupert people (Eldridge et al. 1988).

In an archeological survey of RBMBER, Eldridge et al. (1988) reported prehistoric archeological sites including fish camps, a winter village or long-term camp and a fish trap. Additional evidence of traditional activity in the Tsitika estuary includes bark-strippedtrees, and logged cedar trees. Bark and planks were harvested from living cedar trees for a variety of uses including housing, clothing, and household items (Stewart 1984).

The Kwakiutl consider the killer whale the most powerful spirit in the sea and have never hunted it. Its image appears frequently on totem poles, grave markers and other ceremonial items. According to myth, the killer whale people gave special powers to two kin groups of the Komkiutis tribe living at Robson Bight (Eldridge et al. 1988).

A comprehensive claim for Kwakiutl Tribal Territories is described in the Kwakiutl Declaration (Guenther, pers. comm.; Kwakiutl First Nations, n.d.). Two treaties were signed in 1851 at Fort Rupert between the Queakar and the Quakeolth Tribes and James Douglas, Chief Factor for the Hudson's Bay Company. These treated ceded the Tribes' territories from McNeill's Harbour and Hardy Bay, extending two miles inland. The Treaties provide that the Tribes are at liberty to hunt on unoccupied lands and to carry on their fisheries as formerly.

The Kwakiutl First Nations comprehensiveland claim, regarding territory which includes Johnstone Strait and the lower Tsitika valley, has been accepted by the Federal government for negotiations. However, negotiations have not yet begun.

4.6 Summary

Improved highway access from Campbell River to northern Vancouver Island since 1979 has provided a boost to tourism and coincided with the timing of forest harvesting in the Tsitika watershed. The economy of the north Island continues to be based primarily in forestry, fishing and mining, although tourism is a rapidly growing sector.

5.0 POTENTIAL SOURCES OF DISTURBANCE TO KILLER WHALES

Potential sources of disturbance to killer whales and their habitat may be marine-based or land-based. Marine-based disturbance consists primarily of vessel activity, especially where this occurs in close proximity to whales. Land-based disturbance includes physical alterations to habitat, and human activity at sites where killer whales swim close to shore, such as at the rubbing beaches.

5.1 Marine-based Disturbance

Boats are the most common mode for bringing people into contact with killer whales. Boats are used for fishing, transportation, commerce and pleasure. Vessel disturbance has been identified as one of a number of impacts on an endangered beluga whale population in the Gulf of St. Lawrence in Quebec. A recent agreement between the Quebec provincial government and the federal government provides for land and marine areas to protect a portion of habitat at the confluence of the St. Lawrence and Saguenay Rivers and to limit vessel access. A provincial park already protects the land portion, while a "Harmonization Committee" - with representatives of the Canadian Parks Service and the province - is examining the legal basis and overall objectives for a marine park (Breton, pers. comm.).

Disturbance by boats is the best documented type of impact on killer whales because it is easiest to observe and takes place primarily in the study area. Vessel approaches rarely result in physical harm to killer whales, however there are isolated incidents. In December 1973, a ferry at Comox, south of Campbell River, fatally struck a killer whale with its propeller. Incidents where physical harm is intended still occur. Killer whales still appear occasionally with bullet wounds (Bigg et al. 1987).

5.1.1 Western Johnstone Strait

Duffus and Dearden (1989) described boat-whale encounters in western Johnstone Strait and RBMBER in 1986, 1987 and 1989, while conducting research on whale watching. The emphasis of their research was on recreational boats, charters and researchers. Although it occurred occasionally, whale watching by cruiseships, ferries and other commercial traffic was not recorded. Further studies are required to better establish patterns of whale responses. They defined encounters where boats changed direction toward and approached within 300 m of whales. They found killer whales were most frequently approached by motorized whale watching boats, small power boats and researchers (Figure 5.1). Other kinds of boats approached whales much less frequently. Numbers of encounters by whale watching charters (both motorized and sail), kayaks and sailboats increased significantly between 1986 and 1989. During 1989, whales were typically followed by four boats but boat numbers ranged from 1-12 (Figure 5.2).

Whale watching charter boats and researchers followed whales the longest, about an hour on average (Figure 5.3). Researchers spent up to 420 minutes within 300 m of whales. Other boats remained on average about half an hour following whales. Whale watching charters, sail boats and kayaks tended to remain longer with whales in 1989 than in 1986.

Figure 5.1. Recreational boat encounters in western Johnstone Strait, 1986-89. Data from Duffus and Dearden 1989. Encounters were recorded when a boat changed direction or speed and approached within 300 m of a group of whales. Total encounters (n) = 1064.

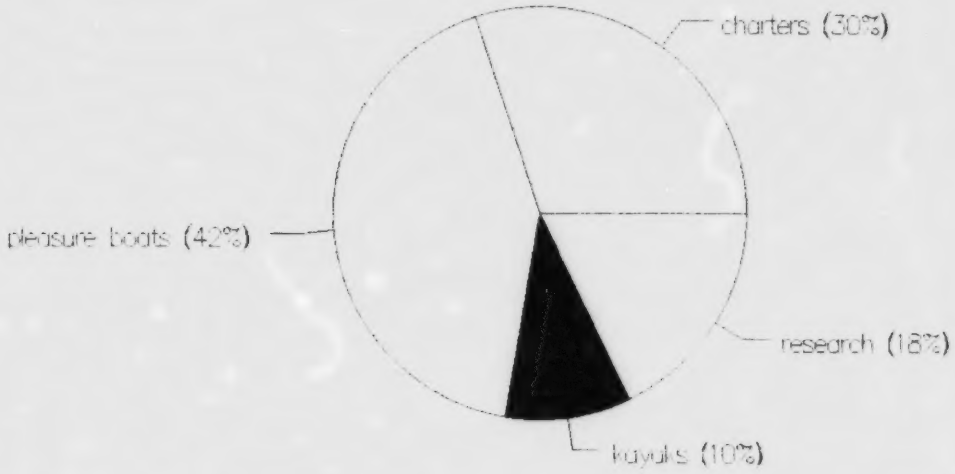


Figure 5.2 Frequency distribution of the number of whale watching vessels simultaneously encountering a group of whales in Johnstone Strait, 1986-89. Data from Duffus and Dearden, 1989.

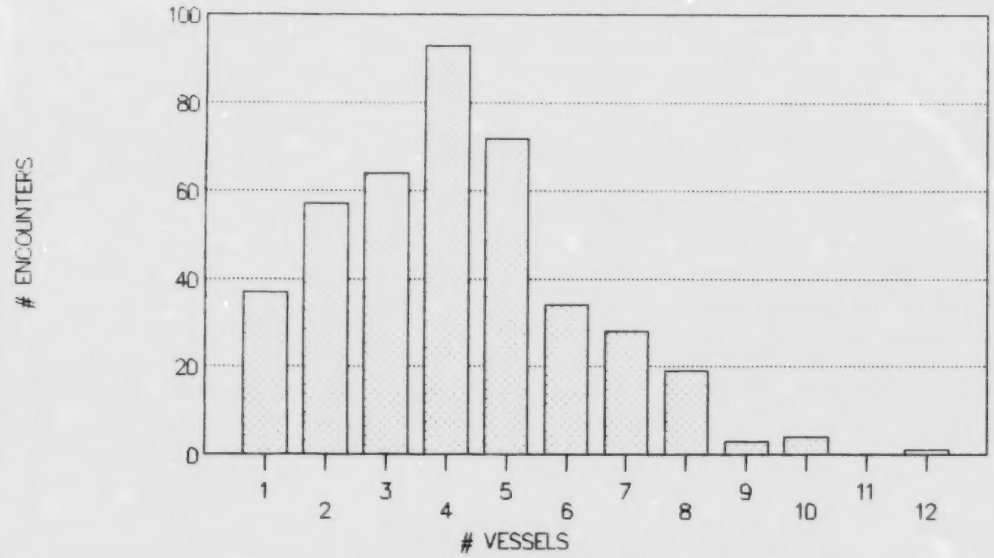
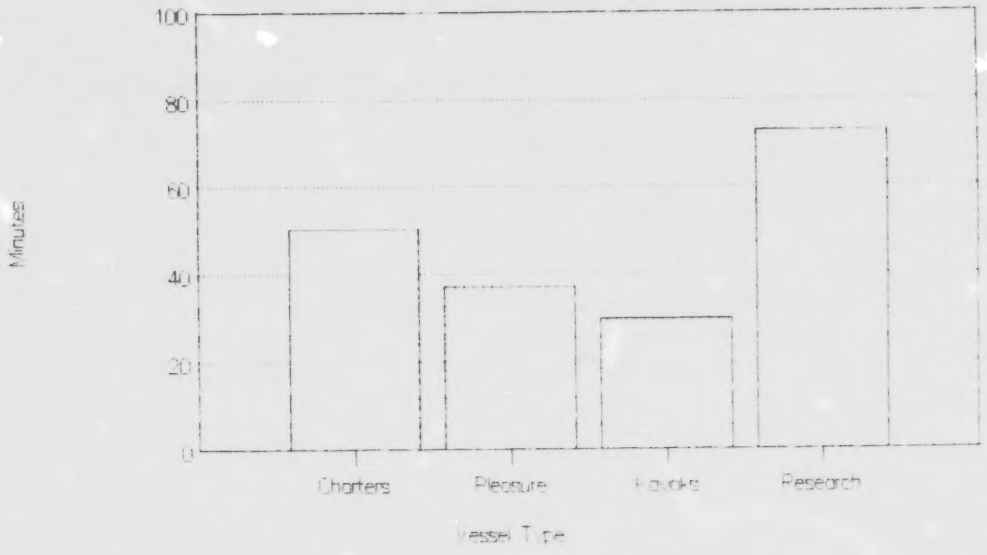


Figure 5.3 Duration of whale watching encounters in Johnstone Strait, 1986-89. Data from Duffus and Dearden, 1989. Total encounters (n) = 1064.



Commercial Fishing Vessels

Commercial fishing vessels are the most common boat type in Johnstone Strait. During 1984-89, an average of 85% of vessels using the Strait were commercial fishing boats (Figure 5.4). Vessel numbers fluctuate widely, being most abundant during fishing openings, and numbering up to 141 at any one time (Briggs 1986). In July and August 1987, an hourly average of 3.7 seine vessels and 1.5 gillnet vessels were observed near RBMBER (Taylor 1988b). The level of commercial fishing activity in any given year is dependent on:

- size of returning salmon stocks;
- the proportion which return through Johnstone Strait; and
- the number of fishing openings.

Most commercial salmon fishing occurs near the Vancouver Island side of Johnstone Strait because of fishery closures or restrictions. Seine boats may set their nets in open water or they may use a limited number of tie-up points on the Vancouver Island shoreline, including some within RBMBER. There are at least 4 tie-ups within the Bight and another 12 between the Bight and Naka Creek (Cranmer, pers. comm.), with some located directly over the rubbing beaches. These tie-up points are often in demand during an opening and may have 2-3 boats waiting in line to use them. Some tie-ups have been in use for many years (ibid.) One of the tie-ups on the eastern shore of Robson Bight has the highest average catch per set in Johnstone Strait (Lewis, pers. comm.).

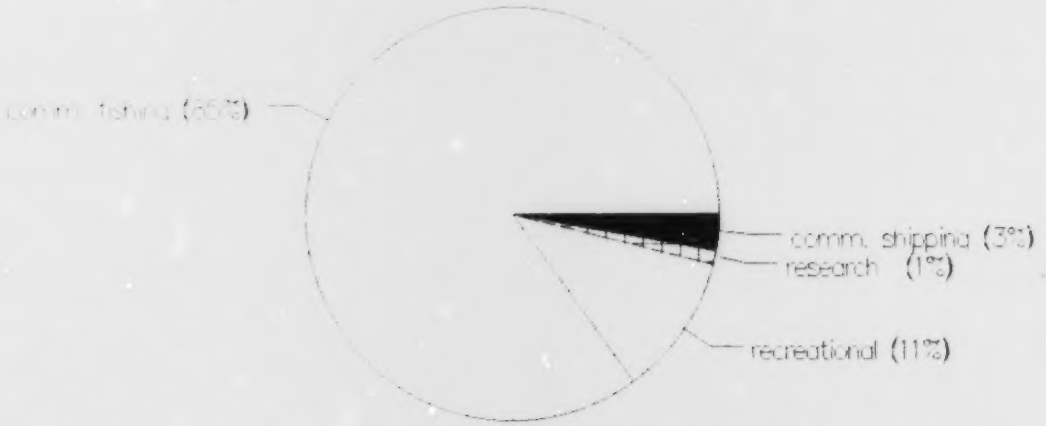
Seine vessels commonly moor for several days along the Vancouver Island shore prior to fishery openings. Sheltered waters within Robson Bight are often used by fish packers and other

vessels during openings and rough weather. Seine vessels typically moor at beach tie-up points to reserve their use for the first set of the next fishery opening.

During the intense commercial fishing activity of July-September in Johnstone Strait, whales swim among and below gillnets and seines set in the area. Typically, killer whales can detect them, although rarely they entangle in gillnets, and if caught, can usually be released alive. Generally, fishing vessels and whales appear to be indifferent to each other, apart from occasional approaches by vessels to whale watch and at the rubbing beaches.

Attitudes within the commercial fishery toward killer whales have changed radically, as have general societal attitudes. In the 1950's and 1960's, killer whales were viewed as threats to be driven away from salmon fishing areas (Department of Fisheries and Oceans 1960). Today, commercial fishermen view killer whales with indifference, tolerance or even interest. They occasionally enjoy whale watching at Robson Bight or listening to whales vocalizing through a hydrophone or underwater microphone (Mackay, pers. comm.). About 1% of the contacts made during the information program at the Reserve were with commercial fishermen who were whale watching (Taylor 1988b).

Figure 5.4 Composition (%) of vessel traffic in Johnstone Strait, 1984-89.
Data from Briggs 1986, 1988, 1991; Taylor 1988b.



Pleasure Craft (excluding kayaks)

Pleasure craft were the second most abundant boat type in Johnstone Strait. Recreational boat traffic in the Strait averaged 11% of total vessel traffic between 1984 and 1987 (Figure 5.4). In 1990, a minimum of 3,300 boat-days in western Johnstone Strait originated from the marina at Telegraph Cove Resort. Recreational traffic also originates from Port McNeill, Alert Bay, Beaver Cove and fishing lodges. Boaters concentrate in local fishing 'hotspots' at the western entrances to Johnstone Strait, Blackney Pass and Weynton Pass.

Sportfishing activity frequently stops when killer whales pass through, and boaters motor over to watch whales. Whale watching sessions in these areas are often of short duration (10-15 minutes), although commonly several boats are present. Encounters with whales in the Weynton and Blackney Passes are more intense than those in the Strait proper, with frequent approaches to within 50 m, higher boat speeds and more rapid changes in boat direction. These boaters are less likely to seek out or come into contact with information regarding guidelines for appropriate boat behaviour while whale watching, because their primary interest is sportfishing.

Kayaks

Kayak activity has been estimated for Telegraph Cove, the main launching area. In 1989, the Telegraph Cove marina operators estimated that 3000 launches had been made (Taylor and Parsons 1989). Approximately 1400-2000 kayak launches were estimated for 1990 by contacting kayak tour operators. The 1990 figures do not represent a decline but rather a difference in the sampling method. In 1989, only a small proportion of the total kayak groups originated from Naka Creek (ibid.). Preliminary observations indicate that the same was true in 1990 (Briggs, pers. comm.).

Kayaks generally travel near shore where reduced turbulence and slacker currents make paddling easier than further offshore. Killer whales also typically travel close to shore and frequently feed in these areas as well. Because paddling is quieter than other forms of boating, killer whales are less able to detect the approach of these craft. Conversely, kayaks sit so low in the water that paddlers do not have the visual perspective to see whales coming. Consequently, 'surprise' encounters between kayaks and killer whales are common.

Whale Watching Charters

Although the whale watching industry in Johnstone Strait has grown from one to 27 operators in 10 years, most activity is carried out by 3-4 operators. Full-time whale watching charters in particular perform an important function of education and controlling whale watching encounters. These tours generally have interpretive programs and emphasize unique values of the area and importance of conservation. Charters, especially the vessels holding 10 passengers or more, 'concentrate' visitors in one place, rather than having a number of smaller boats maneuvering around whales. Charter captains generally show considerable restraint during encounters since they have a vested interest in the continued presence of whales in the area. Smaller part-time operators are generally less informed regarding whale watching guidelines and often have small, maneuverable boats (with a higher potential for disturbing whales). As the whale watching industry grows however, self-policing is no longer completely effective in minimizing disturbance of whales.

Whale watching charter activity is generally concentrated around the western approaches to Johnstone Strait but ranges as far east as Naka Creek. Obviously, this is primarily because the whales are here, but is also related to the travel range of the charter vessels. In 1989, one major operator acquired a faster vessel capable of a larger range. Another full-time charter began operating the same year. As the industry grows, a trend toward larger, faster vessels is likely to continue.

Charter operators rely heavily on a marine radio network for reporting of whale sightings. Operators also use the radio to coordinate activities with each other and attempt to minimize traffic around whales. Operators and researchers often cooperate in finding whales, limiting boat activity, and reporting potential disturbance of whales.

Cruiseships and Ferries

In 1984 and 1985, merchant traffic and cruiseships accounted for 2% of all vessel activity in the western Strait (Briggs 1988). Cruiseships and Alaska State Ferry transits through Johnstone Strait in 1990 were higher than usual. Cruiseship transits for 1984-1988 averaged 196; in 1990, there were 227 scheduled trips (Vancouver Port Corporation 1990). Alaska State ferries typically make 104 transits per year; in 1990, there were 112 (Alaska Marine Highway 1990).

Cruiseships and ferries 'concentrate' visitation even more than charter vessels and occasionally alter course, slow or stop to observe whales in Johnstone Strait. These ships have potential to alter the acoustic environment of whales. Research is currently underway on the acoustic environment of the southern resident community (Osborne, pers. comm.). These findings will potentially have relevance for management of the northern residents.

Research and Photography Boats

The number of research and photography vessels vary from year to year depending on projects and funding, but rarely exceeds 10 boats in a year. Relatively little of the research requires close approaches by boats. No more than three boats have been used in any one season for this type of research. Researchers in recent years have attempted to limit close approaches (less than 30 m) to the time necessary for photo identification or observation of detailed behavioural interactions (less than 0.5 hr per session). However, research observation sessions are on average the most lengthy of whale-boat interactions (Fig. 5.3). There has been no requirement for the clear identification of research boats in the past (other than the small pennants) and these boats have often been mistaken for recreational boats. Research boats have then inadvertently acted as a model for other boats to copy or have been viewed as 'harassing' whales.

Although some professional photographers and cinematographers use their own boat, others use vessels already operating in the area. In recent years, most photographers without permits have avoided the Reserve. Without adequate monitoring, disturbance of whales by photographers is a serious concern.

Other Vessels

Other boat encounters include those with tugs towing logbooms and barges, and numerous other maritime vessels. For the most part, these larger vessels do not alter course to follow whales. Vessels moor in Robson Bight for shelter primarily during winter storms and are not likely to interfere with killer whale use of the area.

5.1.2 Robson Bight (Michael Bigg) Ecological Reserve

Vessel activity in the Reserve was observed during July-August 1987 and 1989 by Briggs (1991) and Taylor (1988b). Average numbers of most boat types were higher outside the Reserve. During the operation of the information officer program in the years 1987-90, recreational boat traffic in the Reserve was considerably reduced particularly when whales were present in the Reserve. Commercial charter activity also took place for the most part outside the Reserve.

Potential for disturbance of whales was different inside the Reserve compared to outside. Whales outside the Reserve reacted to boat presence primarily while resting. Since whales most frequently use the rubbing beaches located inside the Reserve, the potential for disturbance during rubbing activities is virtually non-existent outside the Reserve.

Commercial Fishing Vessels

Similar to the rest of western Johnstone Strait, 75% or more of boats present were commercial fishing boats. They also visited the rubbing beach areas most frequently. Although numbers were highly variable, an average of 11 fishing boats were seen in the Reserve at any one time during August 1987 (Taylor 1988b).

As in other areas of Johnstone Strait, Briggs (1991) reported that seine boats frequently arrive several days early to lay claim to a favourite set location. Seiners line up near the shore to make beach sets. Gillnetters also fish within 10-50 m from shore (ibid.). During fishing operations, additional boats or planes bring in provisions or parts, vessels reposition for the next set, or fish are bought and sold to the cash buyers. Seiners and gillnetters may be present at the rubbing beach area for periods of four to seven days. They often moor on the rubbing beaches, in coves immediately adjacent to the beaches and the east and west points of the Bight at favoured sites (tie-ups).

During 1989, Briggs (1991) reported hearing gunfire on 35% of the days that commercial vessels were moored near the rubbing beaches and more than 500 gunshots were heard. Most shots were directed at shore, but sometimes targets in the water were used, such as jumping salmon. In 1987, a gillnetter was observed charging at killer whales. In 1989, an explosion was heard near a group of whales. In 1990, Briggs (in press) reported frequent disposal of garbage bags in the water and on shore in the Reserve. Drums of used motor oil and other waste were found at the beaches and subsequently removed during periods when fishing vessels were moored in the area.

Pleasure Craft and Kayaks

The second most common boat types in the Reserve were pleasure craft and kayaks. Recreational boats comprised an average of 14% of total vessel approaches near the beaches in 1987 and 1989 (Briggs 1991). Kayak approaches were an additional 7% and 2% of the total in those years. These boaters were routinely contacted by information officers from the Ministry of Parks and encouraged to either leave or remain outside the Reserve. This program probably lowered the number of recreational boats and kayaks that might otherwise have been present in the Reserve. In 1990, higher percentages of recreational vessels, charter vessels and kayaks were recorded, possibly due to different data collection procedures.

Other Vessels

Other vessel activities in the Reserve included tugs towing log booms (often within 100 m of shore) and taking several hours to pass through the area (Briggs 1991). Research/ photography boats and whale watching vessels infrequently visited the rubbing beaches. Collectively, these vessel types annually averaged 1% or less of all vessel approaches at the beaches.

5.2 Land-based Disturbance

Potential sources of short-term land-based disturbance are:

- public access
- road construction activities
- logging

5.2.1 Western Johnstone Strait

Human activities adjacent to the Reserve are primarily associated with logging and are described in Forestry (Section 4.4).

Some recreational activity occurs at suitable beaches east and west of the Reserve on the Vancouver Island shore and on Hanson and West Cracroft Islands. Campsites are at a premium and some were in constant use by kayak groups during the summer of 1990 (Arcese, pers. comm.).

Land use by commercial fishermen is limited to landings in skiffs to attach mooring lines, make beach sets, and for some recreational use.

Several researchers camp along the Johnstone Strait shoreline, generally on West Cracroft Island, to allow good vantage points for viewing whales and boater activity. In 1986, there were five research camps on West Cracroft (Taylor, 1988a). By 1990, only 2-3 camps remained.

With the exception of RBMBER, public access to the shores of Johnstone Strait is unlikely to affect killer whale use of this core habitat. Outside the Reserve, killer whales often travel and forage close to shore, but they rarely rest, socialize or rub there. Whales commonly travel and forage as close as 30 m from the shores of Blackney Pass[4], at sites such as Cracroft Point,

---

[4] Blackney Pass is one of the main routes for whales travelling between Johnstone Strait and Queen Charlotte Strait (see Fig. 1).

southern Hanson Island and northern Harbledown Island. Whales also travel close to shore along West Cracroft Island and along Vancouver Island near Kaikash Creek. These sites have potential for land-based whale watching.

Presently, the rugged shoreline limits land-based access, which also restricts opportunities to approach and potentially disturb whales from land. There are no continuous trails near the water in western Johnstone Strait. Logging access on Vancouver Island reaches the waterline only at Naka Creek, Bauza Cove and Beaver Cove. As mentioned previously, logging access at Naka Creek and in the Tsitika valley has recently been gated to restrict recreational access. On Hanson and West Cracroft Islands, logging access is located inland.

5.2.2 Robson Bight (Michael Bigg) Ecological Reserve

Except for the effects of logging access, it is not known at this time if logging adjacent to the Reserve could potentially affect killer whale habitat and use in the Reserve. Blood et al. (1988) reviewed the potential for forestry activities to negatively affect killer whale habitat. Impacts included those from public access, noise disturbance, hydrologic effects and windthrow. However, neither Blood or Briggs noted any direct impacts of logging activities on killer whales at the rubbing beaches because all logging has taken place away from the beaches.

Public access

As in the rest of Johnstone Strait, public access to Robson Bight is still primarily by water rather than by road because of the rugged topography and lack of development. Land-based activity is generally restricted to short hikes. The estuary of the Tsitika and beaches to the west of the estuary receive some recreational use from kayak groups, commercial fishermen and whale watching charters. In recent years, this use has not increased substantially because organized groups have voluntarily kept visitation to a minimum. From 1987-90, most groups going ashore were contacted by the ecological reserve information officers and asked to minimize their stay and potential impact on whales and the Reserve.

As a result of the Reserve information program and concerted efforts by charter operators, people rarely go ashore near the rubbing beaches (Briggs 1991). Due to their activity in the area, commercial fishermen are the most frequent group ashore. Of 27 landings recorded in 1989, 19 were by commercial fishermen. Typically, they went ashore in skiffs and stayed 5-50 minutes to hike, tie mooring lines, whale watch, check rifle targets or make a fire. Recreational boaters and kayakers went ashore mainly to look for a camp site.

Land-based access to Robson Bight is currently limited. Public access from Schmidt Creek and from the Tsitika Main is restricted by gates and difficult terrain. There is some question as to whether the gates can be adequately monitored to be completely effective. By landing boats in the Reserve, it is possible to approach killer whales from land at the rubbing beaches and from a variety of promontories along the Reserve shoreline. This is consistently discouraged by information officers present at the Reserve seven days a week from June through September.

Noise disturbance

It is not known if the noise associated with road construction and logging could potentially disturb whales at the rubbing beaches. Logging east of the Reserve took place in 1989 in the vicinity of the beaches. Future harvesting in TFLs #25 and #39 is proposed to take place behind 300-700 m land buffer of the Reserve. Due to the distance from the water, noise from road construction and logging are unlikely to have any direct impacts on whale use of habitat (Blood et al. 1988).

Hydrologic effects

It is not known if road building and logging adjacent to the Reserve could result in detrimental hydrological changes in the estuary and at the rubbing beaches. Sedimentation from the Tsitika River and marine transport of sediment are currently being studied (Appendix 4). While changes to the estuary are a concern, they are unlikely to seriously affect killer whale habitat at the rubbing beaches, which are several kilometres from the estuary (McConnell, pers. comm.). However, Blood et al. (1988) considered logging in small high gradient streams close to the beaches (such as Schmidt Creek) east of the Reserve is of more concern as it could potentially affect the beaches, both with debris and sediment transport during storm/snowmelt events. Preliminary results of the marine transport study indicate that much of the material on the rubbing beaches originates from Schmidt Creek (McConnell, pers. comm).

Windthrow

Trees can be blown down if the orientation of logging cutblocks is poorly planned or if prevailing winds are stronger than anticipated. This phenomenon is called windthrow and has been a serious problem in the upper Tsitika watershed. There is concern that windthrow or associated debris could occur at the beaches, and obstruct whale access or use of the beaches. The potential for a 'domino effect' of windthrow to begin adjacent to the Reserve and affect the Reserve boundary was examined west of the Tsitika in a study by T. Lewis for the Ministry of Parks. The potential for windthrow east of the Tsitika has not been examined. Lewis (1989) reported that the open canopy cedar-hemlock forest predominant on the slopes above the Reserve are resistant to wind effects. He concluded that the south boundary of the Reserve generally had low potential for windthrow, except within an area 250 m west of the Tsitika River.

6.0 KILLER WHALE RESPONSES TO HUMAN ACTIVITIES

Certain species of whales respond not only to sudden and unpredictable changes in course by whale-oriented vessel traffic, at distances of at least 400 m, but also may display avoidance responses to non-whale-oriented vessel traffic up to 4 km distant (Atkins and Swartz 1988; NOAA 1987).

As would be expected, killer whales respond to different types of disturbance in different ways. In response to human activities, whales may show short-term behavioural changes, such as leaving an area one day but returning the next. Potential long-term responses include reduced use of a critical habitat or lowered productivity and survival due to changes in the environment, such as decreased food availability or declines in preferred habitat. With lowered productivity or survival, populations would be less able to respond to additional changes in the environment.

Establishing a link between human activities and changes in the biology of killer whales is complex. Many human activities take place in the region that could affect killer whales, such as competition for the same food supply, pollution, habitat degradation and harassment. Human activities may affect, either positively or negatively, many aspects of killer whale biology, such as reproduction, mortality, distribution, social organization and behaviour. In addition, correlation between human activities and a change in whale biology may be cause and effect or entirely coincidental.

6.1 Short-term Responses of Killer Whales

Reactions by killer whales to vessel or land approaches, as previously described, include avoidance behaviours, speed changes, aerial displays (eg. breaching), and changes from one behaviour mode to another (eg. resting to travelling). While these behaviours may happen independently of boat approaches, they occur more frequently when boats are present (Kruse 1984).

6.1.1 Reactions to marine-based disturbance

Western Johnstone Strait

Killer whales avoid boats which approach them too closely by increasing speed, altering direction of travel, diving for longer periods of time or dispersing. Kruse (1984) reported that killer whales in Johnstone Strait increased their swimming speed by 1.4 times during 84 situations in which boats approached within 400 m. Swimming speed tended to be greater with an increase in the number of boats. The size of the boat did not seem to influence the degree of avoidance. Whales did not usually change direction of travel due to disturbance. Duffus and Dearden (1989) reported that while killer whales responses to the speed or direction of boat approaches were variable, groups were likely to disperse.

Killer whales show considerable variability in their reaction to boats depending on:

- the proximity, course and speed of boat approaches;
- the whales' behaviour and apparent mood at the time;
- and the length of time that the whales are followed.

Kruse (1984) found that killer whales showed little reaction to any boat activity more than 300-400 m away. Within that distance, Duffus and Dearden (1989) found that the likelihood of whale avoidance typically increased as boat distance decreased. However, whales are extremely variable in their reactions - sometimes beginning avoidance behaviour at 300-400 m and at other times, not until the boat is considerably closer. As would be expected, some individuals or pods are more tolerant of boat presence than others. So far, there has been no instance of "friendly" behaviour in killer whales, that has been observed in other species. For example, under certain conditions, "friendly" gray whales will approach small boats and solicit touching by the human occupants.

Within 300-400 m, killer whales are disturbed more by frontal approaches than those from the side or rear. A high speed boat approach (> 6 knots) will typically result in killer whale avoidance, such as a change in swimming direction or dispersal of a group. Boats can approach to within 50-75 m if the approach is dead slow (ie. no wake), from the whales' flank and if the whales are in an approachable mood. The same pod may allow a close boat approach on one day, but not on another. Killer whales appear to be disturbed more when approached during resting, socializing or beach rubbing than when foraging or travelling (ibid.). Some habituation to close boat approaches seems to take place as the summer progresses, although Kruse (1984) did not find this. Although not rigourously documented, resting periods appear to have shortened over the years, and groups of resting whales have become smaller.

While short-term disturbances are usually not serious when considered individually, cumulatively they may be a problem. Whales may be followed from the time they enter Queen Charlotte Strait down as far as Kelsey Bay by a succession of boats. The overall effect of these avoidance behaviours may be a long-term change in distribution.

Elsewhere in the world, other species of whales have been known to desert critical habitats apparently in response to vessel traffic and noise (Appendix 5). Gray whales abandoned breeding and calving areas at Laguna Ojo de Liebre in Baja California during the years that heavy barge traffic supported a salt production plant there (Jones and Swartz 1984). The levels of whale watching, 'thrill', commercial and military traffic have been implicated in changes in humpback distribution in breeding and rearing habitat off Maui, Hawaii (Atkins and Swartz 1988).

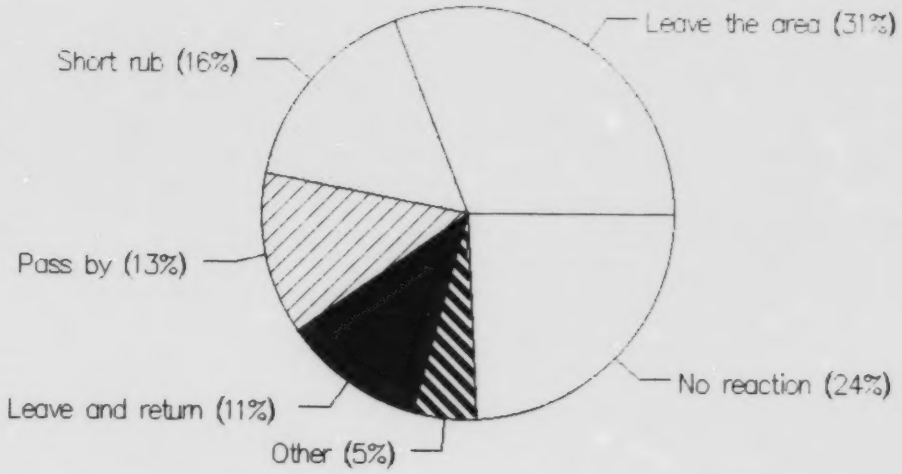
In summary, the extreme variability of killer whale behaviour from day to day, pod to pod and even individually, makes it difficult to make generalizations about reactions (other than when rubbing) to human activity in Johnstone Strait. We do know that killer whales often attempt to avoid boats approaching at speed greater than six knots and that they often react by slapping the water, spyhopping and breaching if approached while resting or socializing.

Robson Bight (Michael Bigg) Ecological Reserve

Briggs (1991) examined the reaction of killer whales as they encountered commercial fishing boats, whale watching boats (charter, research and recreational) and commercial marine traffic near the rubbing beaches (Figure 6.1). Commercial fishing boats accounted for at least half of encounters recorded between whales and vessels in 1987 and 1989. On average, 76% of the 356 total encounters recorded resulted in a reaction by the whales including:

a) leaving the area (31%),
b) having a shorter rub than usual at the beach (16%),
c) passing through the area without rubbing (13%),
d) leaving and then returning (11%) and
e) other reactions (5%).

Figure 6.1 Killer whale reactions to vessel approaches at the rubbing beaches (from Briggs 1991).



Disturbance to whales near the Reserve appears to influence their behaviour when they subsequently visit the rubbing beaches and also the behaviour of whales already at the beaches. Of the 41 interactions noted by Briggs (1991), 73% resulted in whales having a shorter rub, changing direction or passing by. In cases where part of a whale group went to the rubbing beaches and part remained outside the Reserve, when the whales outside were disturbed, those inside the Reserve left the beaches (ibid.).

On an occasion when explosions, perhaps caused by seal bombs, were heard near whales at the beaches, whales reacted by rapidly leaving the area. In two incidents when gunfire was heard from commercial fishing vessels moored near the rubbing beaches, the whales left the area in one case and did not react in the second.

Overall, killer whales at the rubbing beaches reacted to the presence of boats nearby, modifying their behaviour for at least 75% of vessel approaches. As a result, they spent less time in the Reserve than they might have otherwise.

6.1.2 Reactions to land-based disturbance

Killer whale reactions to land-based disturbance in Johnstone Strait have been documented only at the beaches in RBMBER. The reaction of whales to people on the beaches was observed during 1987 and 1989 when people were visible to the whales (Briggs 1991). Briggs reported that "Interactions resulting from the presence of people on shore in all instances resulted in whales leaving the area." This makes a very strong case for limiting access to the rubbing beaches from land.

Killer whales have not been present in any instance when the Peel Main road construction or blasting activity was taking place near Schmidt (Peel) Creek and therefore no interactions have been observed (Briggs 1988).

6.2 Long-term Responses of Killer Whales

Long-term negative responses of killer whales to disturbance would likely be manifested in changes in seasonal abundance and/or decreased reproductive rates as shown in declines in population growth.

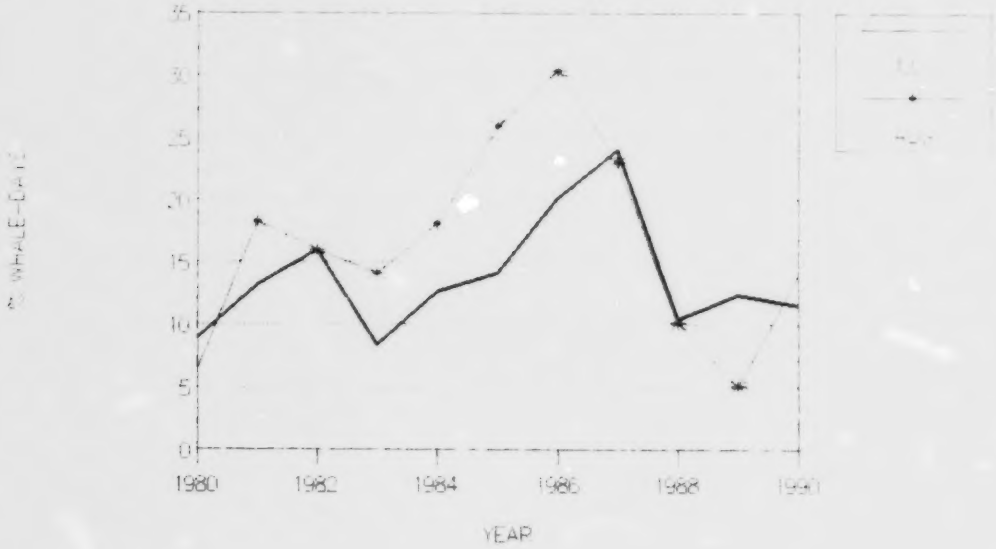
6.2.1 Changes in seasonal abundance

Western Johnstone Strait

All pods have considerable annual variability in their occurrence. For example, the most commonly seen pod (A1) entered the region only once during 1980. C pod, another common pod, was not seen at all in Johnstone Strait during 1979.

Average monthly occurrence of killer whales for July-September 1980-1990 are summarized in Figure 6.2. Analysis was based on the number of **whale-days**[5] recorded in Johnstone Strait.[6] On average, 16.5% of whale-days were spent in Johnstone Strait in the ten year period (more than 20% in 1986 and 1987). Although highly variable from year to year, a large proportion of the northern community's time is spent in this relatively small area of their range. Increased abundance of whale pods coincides with migrations of salmon through Johnstone Strait (Nichol 1990) and at least partially accounts for variability in whale occurrence. No overall impact on whale occurrence in Johnstone Strait by boats and other sources of human activities has be detected during the period of study.

Figure 6.2 **Occurrence of northern resident killer whales in Johnstone Strait, July-August 1980-1990.** Percentages are based on the number of whale-days each subpod was recorded in the study area. One whale-day equals one whale seen on one day. Data from Nichol (1990) and Spong and Symonds (unpubl.).



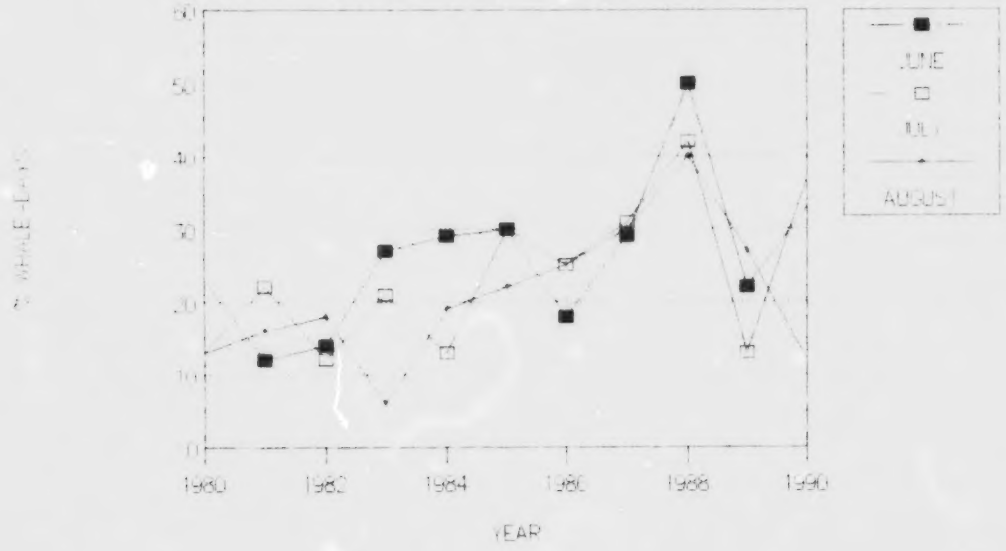
[5] One whale-day equals one whale seen on one day. Percentages were based on the total possible whale-days if all northern residents were seen in Johnstone Strait every day of the study period.

[6] The study area used by Nichol, Spong and Symonds extended further west in Johnstone Strait than that used by Briggs (1991), and included Blackney and Weynton Passages.

Haro Strait

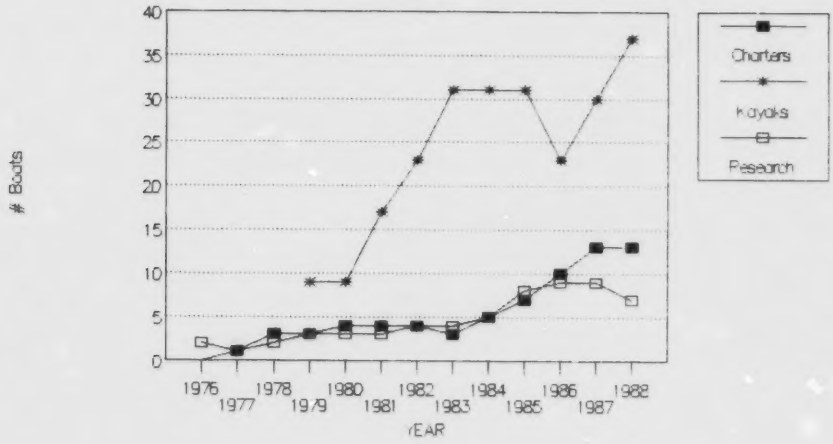
Osborne (pers. comm.) summarized data on the annual proportion of southern resident whales to visit Haro Strait during June-August 1980-90 (Figure 6.3). Haro Strait is the core area of the southern resident community (pop'n 85 in 1989) and thus is comparable to western Johnstone Strait. Southern residents tend to enter Haro Strait about a month earlier than northern residents do in Johnstone Strait. In the ten year study period, southern residents spent 23.4% of their time in Haro Strait (16.5% seen in western Johnstone Strait). Monthly occurrence from year to year was highly variable, eg. 12-50% for July. However, the overall trend has been for whales to enter Haro Strait more often, especially during the late 1980's.

Figure 6.3 **Occurrence of southern resident killer whales in Haro Strait, June-August 1980-1990.** Percentages are based on the number of whale-days each subpod was recorded in the study area. One whale-day equals one whale seen on one day (from Osborne 1988, pers. comm.).



Although more whale sightings may have resulted from better data collecting procedures in the late 1980's, Osborne (pers. comm.) believes that whales spend more time in Haro Strait during 1980-90, despite growth in whale watching activities. During 1977-88, the number of whale watching charter boats in Haro Strait rose from 1 to 13 (Fig. 6.4).

Figure 6.4 **Number of boats in whale watching operations in Haro Strait, Washington** (from Osborne, 1988).



6.2.2 Population growth rates

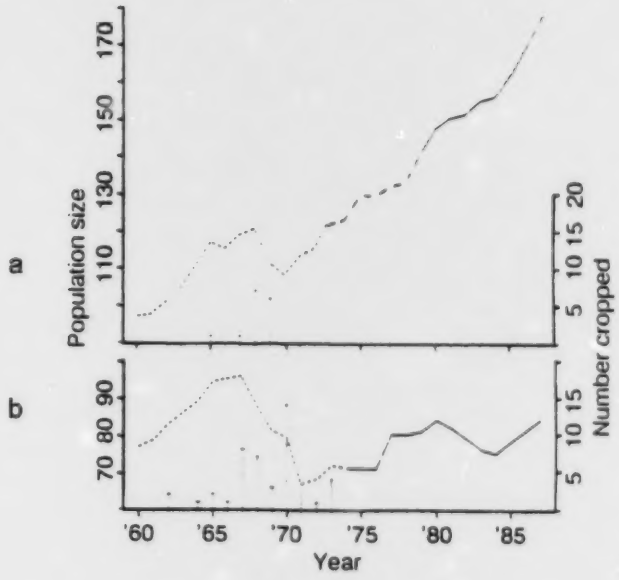
Population growth[7] is the net result of the interaction between many environmental factors and is a critical measure of the relationship between the northern resident killer whale population and its environment. Factors include food availability, habitat suitability and human activities throughout its range, and affect many aspects of killer whale biology, such as reproduction, mortality, disease and behaviour.

The northern resident population has been steadily increasing at an annual rate of 3.0% (Olesiuk et al. 1990). The population may have been expanding at this same rate since 1955 (Fig. 6.5), which is likely near the maximum possible for the population and indicates an optimal environment for the northern community during this period. Despite disturbance by humans, such as short-term disruptions of whale behaviour in Johnstone Strait, population growth rates have not altered substantially. However, the northern community has a large range. The role of Johnstone Strait as critical habitat for this population has not been fully defined, but the reliable occurrence of killer whales here is an indication of its importance.

---

[7] Population growth is defined here as the annual rate of change in population size. This rate of change depends on the number of births and deaths each year; increasing when births exceed deaths and decreasing when deaths exceed births.

Figure 6.5 **Population trends during 1960-87 in: a) the northern community; and b) the southern community** (from Olesiuk et al. 1990). Dashed lines indicate population trends were projected; solid lines show population trends based on complete censuses of all pods in the community. Broken lines indicate that some pods were censused and others were projected. The vertical bars show the estimated number of animals removed from the community during the live-capture fishery.



6.3 Summary

Killer whales in Johnstone Strait exhibit short-term behavioural changes, such as alteration in direction or dispersal, in response to vessel approaches, particularly when the approaches are frontal and at speeds greater than six knots. Whales reacted in 75% of cases where they were approached by vessels at the rubbing beaches, usually by leaving the area. When approached from land at the beaches, killer whales reacted in 100% of cases recorded in 1987 and 1989.

Despite predictable occurrence by killer whales in Johnstone Strait, particularly during the summer, individual pods show considerable year-to-year variability in the frequency of their visits to the area. Research indicates this is likely more related to the availability of prey rather than as a consequence of human activity. Population growth rates (3% per year) of the northern resident community are likely near the maximum possible for such a long-lived species and do not currently show any observed negative effect from human activity in this part of their range.

7.0 MANAGEMENT ISSUES AND CONCLUSIONS

7.1 Key Agency Roles

The lead agencies involved in mangement of killer whales and killer whale habitat in Johnstone Strait are the Department of Fisheries and Oceans and the Ministry of Parks. A generalized representation of present management in Johnstone Strait is shown in Figure 7.1.

7.1.1 Department of Fisheries and Oceans

The federal Department of Fisheries and Oceans is the agency primarily responsible for management of killer whales in Canadian waters. Legislation under the Department of Fisheries and Oceans Act provides for management of coastal and inland fisheries, fisheries science, fishing and recreational harbours and oceanography and hydrography. Management of whales is within the jurisdiction of the Fisheries Act and associated regulations. There is no mandate to manage killer whales differently from other whale species. However, the Department has the same responsibility for killer whales, such as protection of habitat, enforcement and research, as for other marine animals and plants whether of commercial value or not.

Under the Fisheries Act, the Department controls the location and dates of commercial fishing in B.C. coastal waters, including within RBMBER. The Cetacean Protection Regulations of the Act provide jurisdiction to prevent chasing, shooting at or harassing of whales. However, a legal description of harassment has yet to be formulated. As the problem of disturbance by commercial fishing vessels had not been studied until 1987 (Briggs 1988), no restrictions had been placed on commercial fishing activity in the Reserve to specifically protect killer whales. Until harassment is legally defined or some other mechanism found to control disturbance, the main instruments of the Department of Fisheries and Oceans for controlling harassment are whale watching guidelines and education.

Other regulations could potentially be used as a model for legislation to control activities regarding whales on the British Columbia coast. For example, the Beluga Protection Regulations of the Fisheries Act specify certain geographic areas where activities outlined in the regulations may take place.

Under Section 35 of the Fisheries Act (1990), the Department has authority to ensure that logging operations do not adversely affect freshwater and marine habitats, including habitat for killer whales. Staff from the Department have been part of the Tsitika Follow-up Committee since its inception in 1978 and have closely monitored logging practices in the Tsitika Valley. The Committee reviews logging plans to ensure that the intent of the Tsitika Watershed Integrated Resource Plan is being met.

Figure 7.1 Present management of Johnstone Strait killer whale habitat.

LEGEND

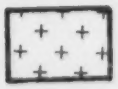
Robson Bight (Michael Bigg) Ecological Reserve

LAND No camping, lighting of fires or consumptive uses as per Ecological Reserves Act.

WATER Visitor information program and reserve management under B.C. Parks. Guidelines for no recreational or commercial charter activity in the Reserve when whales are present. Research allowed in Reserve only under permit. Commercial fishing activity and shipping traffic unimpeded.

Information buoys marking the marine extent of the Reserve.

Cetacean Protection Regulations of the Fisheries Act apply, as in all Canadian waters where cetaceans (whales) are found. It is unlawful to disturb, harass whales. Enforced only where physical harm to whales has taken place or is suspected.



Potential forest management and access activity as approved by the Tsitika Follow-up Committee. Ecological reserves and wildlife ranges cover 1903 ha. Recreational access restricted by gate at Catherine Creek and Naka Creek.

Other planned forest management and access activity.

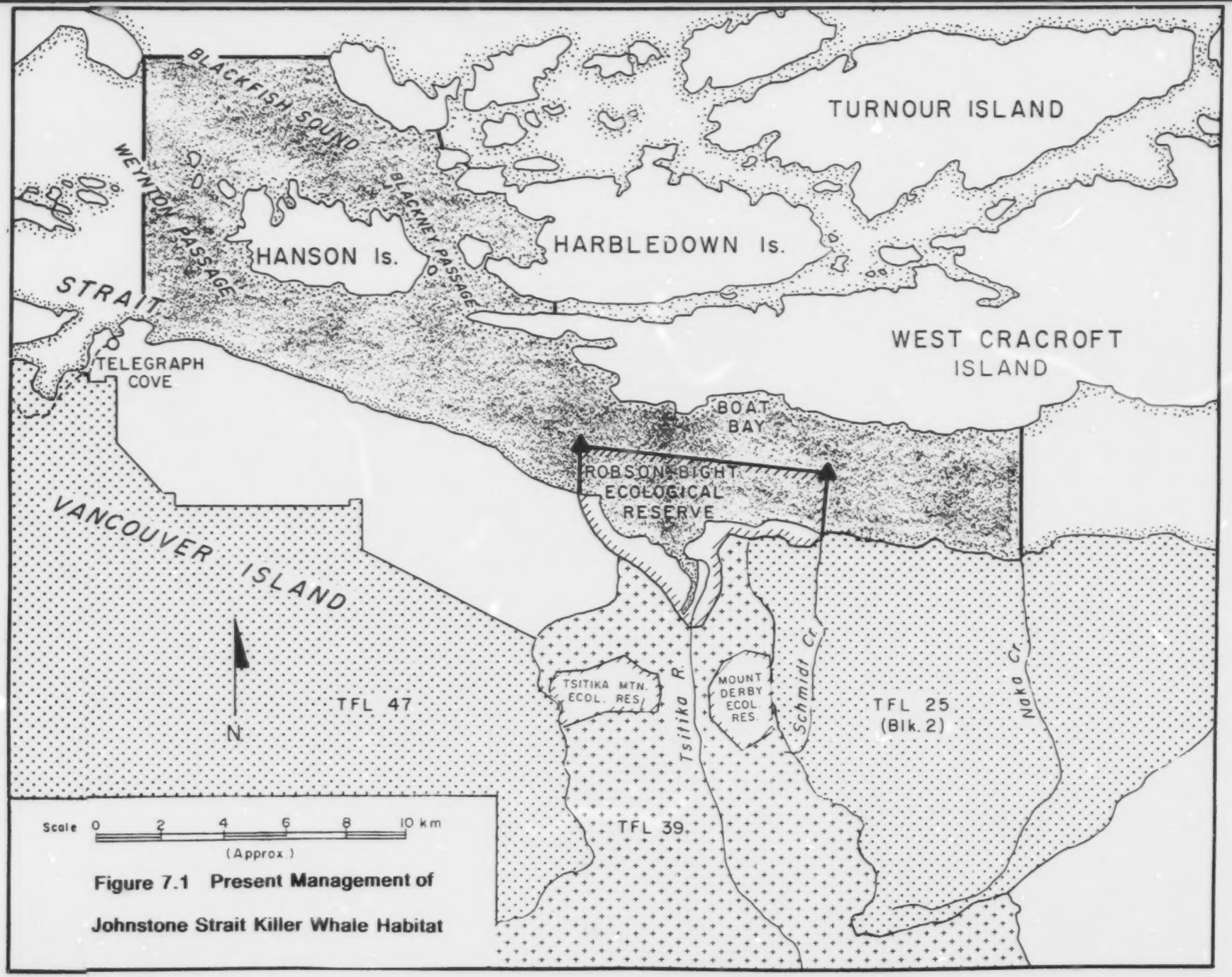


Figure 7.1 Present Management of Johnstone Strait Killer Whale Habitat

7.1.2 British Columbia Ministry of Parks

Responsibility for protection of killer whale habitat also lies with the Ministry of Parks which provides, under the Ecological Reserves Act, for preservation of the rubbing beaches and surrounding area at Robson Bight. Technically, provincial jurisdiction is limited to the land covered by water (Order-in-Council1134) and to the upland portion of the Reserve. Ecological reserves are expressly protected from incompatible development. Three major objectives of RBMBER are:

1) to protect a core habitat for killer whales;
2) to prevent whale harassment in the Reserve; and
3) to provide long-term research and educational opportunities without disrupting killer whale use of the area.

To achieve these objectives, the Ministry of Parks has:

- established a marine reserve in 1982
- acquired a 505-ha upland addition for the Reserve to protect the estuary and forested slopes, and to buffer the killer whales from proposed logging in the Tsitika watershed;
- sponsored a volunteer warden program;
- developed a public information program as its main management tool to prevent whale harassment (described in Section 7.3.2)
- commissioned or contributed to research projects to evaluate the possible impacts of human activities on killer whales in the Reserve (described in Section 7.3.2);
- participated since 1978 in the Tsitika Follow-up Committee, which reviews all logging plans in the Tsitika watershed - as a result of this work, six ecological reserves, including RBMBER, have been established in the Tsitika valley;
- controlled research and photography activities in the Reserve through a permit system; and
- implemented through the Canadian Coast Guard several information buoys and markers showing the marine extent of the Reserve.

The Ministry of Parks can limit land access on ecological reserves under the Ecological Reserves Act as is done for some other reserves. To date however, casual use and landing for commercial fishing operations at the Reserve have not been restricted. The Ministry has no control over the marine waters but has jurisdiction on the land covered by water, which includes the rubbing beaches. The result of studies commissioned by the Ministry and by others contribute to the knowledge base that the Ministry of Parks will use to determine appropriate management actions in the Reserve.

7.1.3 Management objectives

The Federal and Provincial governments, as represented on the Johnstone Strait Killer Whale Committee, have two broad management objectives concerning killer whales:

1) to control human disturbance of the whales in RBMBER and western Johnstone Strait; and
2) to protect whale habitat in the RBMBER.

Four specific issues arise out of the management objectives:

1) Commercial fishing and mooring in RBMBER.
2) Recreational boaters, whale watching charters, researchers and photographers in western Johnstone Strait and RBMBER.
3) Land access to RBMBER.
4) Logging activities near RBMBER.

7.2 Commercial Fishing

7.2.1 Issue: Commercial fishing and mooring in the RBMBER

Commercial fishing outside the Reserve is not seen as a major source of disturbance to killer whales. This is not the case inside the Reserve. RBMBER is important to killer whales primarily for rubbing on beaches and resting close to shore, especially in the Bight area. The unusual characteristics of the Reserve for this rubbing behaviour are now recognized world-wide. The biological significance of beach rubbing is not known, but may partially account for the predictable travel pattern of killer whales in Johnstone Strait. With this possibility in mind, it is prudent to be cautious when considering activities that reduce the whales' use of the area. Recent studies have shown that killer whales in Johnstone Strait spend over 20% of their time in the Reserve, resting, feeding and/or rubbing (Briggs, in prep.)

The Reserve is also used by commercial salmon fishermen to set their nets, to tie their nets to shore and to moor their boats. Between openings, fishermen are often out in skiffs visiting other boats, target-shooting, fishing, watching for signs of fish accumulation, whale watching or exploring on land. Although whales and commercial fishing have coexisted for many years, the whales' use of the Reserve appears to be reduced by commercial fishing, mooring and associated activities in the Reserve (Briggs 1988, 1991). The cumulative effects of commercial fishing in the Reserve, coupled with increased boat traffic of other types, may further reduce killer whale presence.

7.2.2 Current management practices

The Department of Fisheries and Oceans does not limit fishing activities in the Reserve for reasons of whale or whale habitat conservation. Furthermore, commercial fishing activities are presently exempt from the provincial restrictions placed on whale watching and land activities in the Reserve. Although within the mandate of the Fisheries Act, there have been few attempts to control disturbance to whales because a legal definition of harassment is lacking.[8] Fisheries officers patrol the salmon fleet during the summer and generally do not intervene in cases of disturbance of killer whales unless there is potential for physical harm to whales, ie. where harassment can more easily be proven.

---

[8] An unsuccessful prosecution for shooting at killer whales was undertaken in 1984 (Ellis, pers. comm.). This case had the potential to set a legal precedent for the definition of "harassment" on the basis of which is described in the Cetacean Protection Regulations of the Fisheries Act. Recently, another potential test case has come before the courts. The Department of Fisheries and Oceans has pressed charges against an individual for alleged harassment of whales with a boat.

About 1% of contacts made by information officers during the BC Parks were with commercial fishermen. Contacts were generally made when fishermen were pursuing leisure activities in the Reserve such as whale watching or exploring (Taylor 1988b).

7.2.3 Key agencies and groups

Major agencies and groups having an influence on commercial fishing disturbance of killer whales in the Reserve:

Groups	Role in reducing disturbance
1. Commercial fishing industry	• Reporting of harassment; tolerance of whale presence; possible educational role within the fishing industry.
2. Department of Fisheries and Oceans	• Patrol vessels enforce regulations to protect killer whales from harassment (ie. shooting, seal bombs, etc.) when occurrences are reported.
3. B.C. Ministry of Parks	• Information program and studies in the Reserve to monitor use, determine impacts and disseminate information re: resource values, boundaries and whale watching guidelines.

7.2.4 The future

Levels of commercial fishing in the Reserve have remained essentially the same over the past few decades. Commercial seining began in the 1950's in the Strait. Allocation of the salmon catch between commercial, sportfishing and Native interests shows potential for change along the entire British Columbia coast. Patterns of fishing may change with these alterations in catch allocation. Some interference with the whales' natural use of the Reserve will likely continue unless action is taken. In recent years, some commercial fishermen have taken an interest in whale watching during their leisure time.

7.3 Whale Watching, Research and Photography

7.3.1 Issue: Whale watching by recreational boaters, charters and researchers/photographers in Johnstone Strait and RBMBER

Western Johnstone Strait and RBMBER are among the most reliable places in the world to see killer whales. Tourists, researchers and photographers come from around the globe and most want to get close to the whales. However, close approaches and prolonged following can result in disturbance to the whales. Whale watchers try to anticipate the whales' location and often follow them, once found. Several boats may follow one pod. Whale watchers frequently approach the Reserve to see killer whales, resulting in added boat noise and activity.

Disturbance has increased through the 1980's associated with a sharp rise in whale watching. Other species of whales have abandoned critical habitat at other locations, apparently in response to human activities in the area (Jones and Swartz 1984; Atkins and Swartz 1988). Short-term alteration of killer whale behaviour in the Strait and the Reserve has been clearly shown. As well, encounters with vessels appear to limit killer whale presence in the Reserve. Although long-term detrimental impacts from boat activity and noise have not been observed, such a cumulative impact is possible if sufficient disturbance takes place.

7.3.2 Current management practices

Western Johnstone Strait

The Department of Fisheries and Oceans has used a system of pennants and whale watching guidelines in Johnstone Strait. From 1985-86, numbered yellow pennants were provided by the Department of Fisheries and Oceans for researchers and photographers to fly on their boats for identification. Pennants were intended as signals to other boaters to stay clear and applied equally in Johnstone Strait and the Reserve. Guidelines for boaters were issued in 1985 (Appendix 6) and were also published in Bigg et al. (1987) where they have reached a large readership of potential whale watchers. Researchers are exempt from the 100 m distance guideline only where close approaches are necessary. Boaters are requested to:

- **approach whales from the side or rear, not the front**
- **not approach closer than 100 m**
- **approach and depart slowly**

Attempts to alter whale watching practices through the use of the guidelines and the pennants has been sporadic and ineffectual. Warnings have been given only occasionally in cases of intentional harassment. The effectiveness of the guidelines has not been monitored. There are currently no limits on the number of boats approaching a group of whales or the length of time that a pod may be watched by any one party. Pennants were discontinued because it was uncertain who should be issuing them. In addition, other boaters had difficulty seeing pennants and understanding their purpose.

Robson Bight (Michael Bigg) Ecological Reserve

Since 1982, the Ministry of Parks has instituted a number of management programs for RBMBER, including volunteer wardens, an information program, whale watching guidelines, management studies and a permit system. The Ministry also responds to information needs by distributing Reserve descriptions, research reports and presenting slide shows on the need to protect this Reserve and its whale habitat.

Volunteer wardens

From 1982 to the present, two volunteer wardens have regularly visited the Reserve to monitor use, maintain signs and educate the public regarding conservation of the Reserve's values.

Information program

Each summer during 1987-90, at least two information officers have been present at the Reserve full-time to contact whale watchers. Recreational craft near the Reserve were approached by officers in an inflatable boat and introduced to the Reserve, its purpose, and appropriate whale watching techniques. Visitors were told about current research being undertaken, where they might see whales outside the Reserve and were invited to listen to the whales with the aid of an underwater microphone (hydrophone). Boat activity was monitored and whale sightings contributed to the research network. Signs posted near the Reserve boundaries and at Telegraph Cove provide additional information.

Wherever possible, the information officers have given talks to tourists and recreational fishermen concerning the Reserve and killer whales. In 1987, there were regular slide talks in Telegraph Cove. Slide talks have also been part of B.C. Parks special events.

Whale watching guidelines

In 1982, guidelines were established for whale watching boats inside the Reserve. The guidelines, distributed in the RBMBER brochure (Appendix 6), request that boaters:

- **refrain from entering the Reserve when whales are present**
- **if whales are encountered within the Reserve, keep at least 300 m away from them**

The brochure is distributed in the Reserve during the summer months as part of the information program, in Telegraph Cove, in the Park District office and on request from the Ministry of Parks. The media are also regularly informed of the Reserve and guidelines, during contacts with regular Park staff, information officers or volunteer wardens.

The whale watching guidelines are generally adhered to by charter operators, researchers and other informed boaters. Some recreational boaters, unaware of the guidelines, may naively enter the Reserve where they are usually intercepted by the information officers. Most people complied readily once they understood the purpose of the guidelines and the Reserve. However, the guidelines have limited effectiveness for uncooperative whale watchers because they are not backed up by appropriate legislation[9].

Management Studies

The Ministry of Parks has subsidized research on management issues since 1986. Funding has been provided to partially or totally fund research and reports on the possible impacts of whale watching (and other uses) on killer whales in the Reserve. Totally funded studies include Darling (1986), Briggs (1988, 1991, in prep.), Blood et al.(1988), and Lewis (1989) Partially funded studies include Taylor (1988a, 1988b) and Duffus (1988).

---

[9] The Ecological Reserves Act is provincial legislation which has no authority for marine waters. Currently, there is no agreement for enforcement of Federal legislation, such as the Fisheries Act, by provincial representatives within marine ecological reserves. The Fisheries Act is the body of legislation in Canada regarding the management and protection of whales.

Ecological Reserve Permits

Researchers and photographers in boats have been asked not to enter the Reserve except when absolutely necessary. If entry is required, they are asked to comply to conditions of Ecological Reserve permits regarding approach, length of time spent with whales and activity at the rubbing beaches. Typically, only one to two Ecological Reserve permits are issued each year for research and photography on land at the rubbing beaches. These are issued with strict conditions regarding visibility, camping, moorage, number of people and dates and are also useful in documenting research activities. No permits for photography at the beaches have been issued since 1988, to limit disturbance of the whales.

7.3.3 Key agencies and groups

The main agencies and groups having an influence on the disturbance of killer whales by recreational boaters, whale watching charter operators and researchers/photographers in western Johnstone Strait and RBMBER are as follows:

Group	Role in reducing disturbance
1. Recreational boaters	• Adherence to whale watching guidelines.
2. Whale watching charter operators	• Adherence to whale watching guidelines and set good example. Information distribution to public.
3. Researchers/ photographers	• Adherence to whale watching guidelines and permits. Research to assess and control disturbance. Information distribution.
4. Department of Fisheries and Oceans	• Issue general whale watching guidelines with 100 m approach limit on the Strait. Information distribution.
5. B.C. Ministry of Parks	• Issue Robson Bight whale watching guidelines with 300 m approach limit. Issue permits for land-based research and photography in the Reserve. Seasonal information program and volunteer wardens in Reserve. Subsidize research re: human impacts on whales. Distribute reserve and research information to the public and researchers.

7.3.4 The future

Numbers of whale watching charter operators and recreational boaters using western Johnstone Strait are expected to continue increasing and may result in additional disturbance to the whales. Numbers of researchers and photographers seem unlikely to change substantially during the next decade. Research is necessary to continue monitoring the impact of human activities on whale biology. Professional photography, especially for documentaries, plays an important role in public education for whale conservation. Education will be especially important if public access to the Reserve is more limited in the future.

7.4 Land Access

7.4.1 Issue: Land access to the RBMBER

The Reserve was only accessible by boat until a logging road (Naka Creek-Peel Main) was extended to the eastern boundary of the Reserve in 1987. This road has a gate located at least 10 km away from the Reserve; close to the Reserve, steep terrain limits access to the water. Another road is proposed for extension along the Reserve's southern boundary; this road (the Tsitika Main) is gated at least five km away from the Reserve. Without long-term control, these roads could facilitate public access to the Reserve shore for hiking and viewing whales. More human activity on the Reserve's beaches would be detrimental since whales avoid humans here and would therefore make less use of the beaches and possibly of the Bight area (Briggs 1991, in prep.). During 1987 and 1989, Briggs (1991) reported only one case of access by land (before the Naka Creek-Peel Main road was gated). All other instances of human presence at the beaches resulted from boat landings.

7.4.2 Current management practices

Minimizing land access to RBMBER has been a policy of the Ministry of Parks within the Tsitika Follow-up Committee. An upland buffer strip (505 hectares) along the entire length of the Reserve was acquired in 1988-89 to provide a deterrent against shoreline access. During the summers of 1987, 1989, and 1990, information officers monitored landings and contacted recreationists in the Reserve. Western Forest Products and MacMillan Bloedel have erected and posted gates on road access near the Reserve to restrict access. Since May 1990, MacMillan Bloedel has had a person stationed on the Tsitika Main to survey visitors and provide some security.

7.4.3 Key agencies and groups

MacMillan Bloedel controls road access through the Tsitika valley to the Reserve boundary. They erected and control the gate at Catherine Creek at the request of the Ministry of Forests. Similarly, Western Forest Products has erected a gate on the Naka Creek-Peel Main road. These groups and agencies are members of the Tsitika Follow-up Committee.

7.4.4 The future

Future demand for land access to view whales will likely increase as tourists become more familiar with remote areas of northern Vancouver Island. Major highway improvements in the next ten years, such as the planned Inland Island Highway, are expected to increase traffic to the North Island.

7.5 Forest Management

7.5.1 Issue: Logging activities near RBMBER

Studies have been undertaken (Appendix 4) to determine whether logging on the lands surrounding the Reserve could potentially:

- result in more variable flows in Schmidt Creek and the Tsitika River;
- increase erosion and siltation;
- increase the risk of blow-down of timber in the Reserve; and
- increase noise and disturbance during road-building and harvesting activities.

Logging and road construction can cause changes in stream flow which can, in turn, cause detrimental impacts on fisheries habitat. The exposure of mineral soils can accelerate the erosion and transport of sediments into stream channels. Physical damage can occur as a result of logging and road building equipment operating in the channel or close to the banks. Logging can introduce debris which may precipitate debris torrents and destroy habitat.

Techniques used to prevent these potential impacts include avoidance of steep slopes and unstable terrain, backhauling excess road construction material rather than sidecasting and proper culvert installation.

Terrain mapping to identify unstable slopes has been completed for the Tsitika and Schmidt watersheds and the Tsitika Follow-up Committee has incorporated mitigative measures into the harvesting plan to minimize impacts on the Tsitika River and estuary such as rigourous minimum road specifications and summer timing restrictions on work which could directly affect streams. The road would be a minimum of 150 m from the river, and while cutblocks 101 and 104 are adjacent to the river, the portions between the river and the road have been deferred, thus providing an undisturbed 150 m buffer on the slope and flats adjacent to the river.

Given the active oceanographic environment of Johnstone Strait and the distance between the rubbing beaches and the mouth of the Tsitika River (3+ km), sediments from the river are unlikely to be deposited on the rubbing beaches. Schmidt Creek, less than 0.5 km away, is a more likely sediment source (McConnell, pers. comm). While no adverse effects of logging on the whales' use of the Reserve have been recorded, logging near the Reserve only began in 1987 and the full effect of such activities has not yet been determined. Preliminary results of a sediment transport (littoral drift) study indicate that logging in the Schmidt Creek drainage could potentially accelerate deposition of materials on the rubbing beaches (McConnell, pers. comm.).

Reduced forest cover can lead to increased peak flows in watersheds but as long as the proportion of unforested land is not excessive, peak flows resemble natural fluctuations (Golding 1987) and are probably not important with respect to erosion processes (Harr 1986). Increases in peak flows in Carnation Creek were not detected even when 40% of the watershed was harvested (Hetherington 1987). The rate of cut in the Tsitika watershed is at a level that would not be expected to result in increased peak flows.

Two storm events in November 1990 caused a 50-year flood and high sediment loads in the Tsitika River (Hogan, pers. comm.). Sediment sources included river banks in forested areas, cutbanks and roads. A study is currently underway to quantify the sources and their sediment yields. In addition, the storm delivered a large amount of woody debris to the estuary. Virtually all of this debris was derived from forested areas. Many of the logs were fresh but a significant number came from historic logjams. Several landslides and slumps also occurred with the large majority originating in unlogged terrain (Hogan, pers. comm.).

Noise and disturbance from road-building and harvesting close to Robson Bight could potentially disturb the whales. Potential disturbance would be minimized if such activities were scheduled to occur during times of the year when whale use is minimal.

7.5.2 Current management practices

A land buffer (505 hectares) was acquired by the Ministry of Parks in 1988 to prevent potential habitat degradation and disturbance as a result of logging and access. The Ministry also commissioned a study to determine the windfirmness of the Reserve's upland boundary, west of the Tsitika River. Both the Ministry and Department of Fisheries and Oceans participate on the Tsitika Follow-up Committee, an agency-industry-publictask force which reviews logging plans to ensure that forestry practices do not impair water quality or fish/wildlife habitat in the Tsitika valley. Harvesting and road-building practices follow the Coastal Fisheries Forestry Guidelines.

As stated earlier, two studies have been initiated recently by the Ministry of Forests under the auspices of the Tsitika Follow-up Committee. Marine transport of sediments is being examined in the vicinity of the Tsitika estuary and Schmidt/Peel Creek. In addition, a long-term monitoring and research study of sedimentation from the Tsitika River has begun.

7.5.3 Key agencies and groups

The main agencies and groups which influence forest management in the vicinity of RBMBER are:

Group	Role in preventing logging impacts
1. Tsitika Follow-up Committee (TFC) (Appendix 4 gives full membership list)	• Ensure that the Tsitika Watershed Integrated Resource Plan (TWIRP) is followed. Identify and facilitate required research and monitoring.
2. B.C. Ministry of Forests	• Ensure logging operators adhere to Coastal Fish-Forestry Guidelines and TWIRP. Support research for TFC.

Other members of the Tsitika Follow-up Committee contribute to forest management vis-a-vis potential impacts on killer whales as follows:

3. MacMillan Bloedel	• Adhere to Coastal Fisheries-Forestry and Tsitika guidelines. Liaise with BC Parks re: potential for windthrow, access and related problems.
4. Western Forest Products	• Adhere to Coastal Fisheries-Forestry Guidelines. Liaise with BC Parks re: logging plans adjacent to RBMBER boundary in rubbing beach / Schmidt Creek area.
4. Department of Fisheries and Oceans	• Monitor logging operations. Enforce regulations to prevent aquatic habitat degradation.
5. B.C. Ministry of Environment (Wildlife Branch)	• Monitor logging operations to ensure wildlife habitats are not impaired. Management of critical wildlife ranges within the watershed.
6. B.C. Ministry of Parks	• Manage use of the RBMBER. Enforce regulations to maintain integrity of 6 ecological reserves in the Tsitika watershed. Influence peripheral land use and logging plans. Commission studies on potential impacts of logging on RBMBER.

7.5.4 The future

The problem of determining the impact of logging practices on killer whale use of the Reserve is complex and poorly understood. To understand the problem more fully, long-term sediment monitoring and short-term marine circulation and coastal processes studies are currently underway.

Depending on the outcome of land claims negotiations regarding the Kwakiutl Tribal Territories (see section 4.5), there is future potential for the Kwakiutl to become more involved in the management of forest resources in the vicinity of RBMBER.

8.0 MANAGEMENT APPROACH AND OPTIONS

Johnstone Strait is internationally recognized as the best location in the world to view wild killer whales. The predictable occurrence of killer whales in this area to feed on salmon, socialize, rest and to rub on pebble beaches near Robson Bight provides an indication of its importance in the ecology of this population. The northern resident population of killer whales is increasing at a rate of 3% per year, a relatively rapid rate for a species with a potential lifespan of 50-75 years. Currently, this growth rate does not reflect long-term negative effects of human activity in Johnstone Strait, or elsewhere in their range. However, human uses of this area are causing short-term disturbance of killer whales in the area and can potentially conflict with whale occurrence here. Additional management is needed to ensure the continued presence of killer whales in Johnstone Strait and RBMBER, in traditional patterns of use and occurrence.

8.1 General Management Approach

Four approaches are proposed for managing human activities potentially affecting killer whales in Johnstone Strait: education, research, resource management, and enforcement and legislation. The rationale for using each approach is as follows:

EDUCATION: Education has been found to be the most effective measure in reducing human impacts on whale populations in Johnstone Strait as well as elsewhere in the world. Education measures are flexible, relatively fast to implement, and can be tailored to involve the very people who interact with whales and the public at large. An education program can be used as the first phase of an overall management strategy and works best when combined with an effective enforcement program.

RESEARCH: Long-term research is necessary to improve our knowledge of these whales and to learn how best to minimize impacts to them. Long-term research in Johnstone Strait has yielded the most significant information on killer whales in the world. However, many gaps in knowledge of their life history still exist.

RESOURCE MANAGEMENT: There is a need to allow continued resource extraction/use in Johnstone Strait, while minimizing the impact of these activities on killer whales. Decisions regarding specific area and resource management and allocation are best undertaken in cooperation with Native and non-Native user groups and the public. They, ultimately, will ensure the proper management of activities and of killer whales in the area. Resource management also provides the vision and direction required to periodically re-evaluate the situation and ensure the other three approaches continue to be effective.

ENFORCEMENT: Legislation provides the final, but "last resort", management tool to ensure the protection of killer whales and their habitat. Legislation, in conjunction with an effective enforcement capability, can provide an effective back-up to minimize impacts of human activities on whales and to provide support for effective education, research and resource management programs.

8.2 Specific Options

Based on the general management approaches described above, specific management options are outlined to minimize impacts of the major resource activities on killer whales. Options for management and expected consequences are provided for commercial fishing, whale watching, access and forest management.

A broad range of options is given for each type of activity; these have not been ranked or prejudged as to their desirability. Each issue has a status quo option, in addition to a range of options covering education, research, resource management and educations. Some duplication exists as several options are applicable to more than one issue. Many options are not mutually exclusive and therefore could be combined into one management strategy.

We invite your ideas as to the desirability of these options. In addition, there may be other options we have not considered.

8.2.1 Commercial Fishing in RBMBER

Summary of Issue:

In Johnstone Strait as a whole, there is no evidence at this time that commercial fishing has measurable impacts on killer whales. However, it has been clearly shown that commercial fishing activities in RBMBER, particularly at the rubbing beaches, have an impact on whales and result in killer whale leaving and/or avoiding a preferred habitat.

	OPTION	CONSEQUENCES
i)	**status quo** fishing and mooring	- continued disturbance of whales - no fishing restrictions
ii)	continue fishing and mooring but **provide an education** program for Native and non-Native fishermen	- reduced disturbance of whales - some restrictions on commercial fishing vessel movements in the Reserve - no fishing restrictions - may reduce disturbance of whales outside Reserve
iii)	undertake **research** into ways to minimize impact of commercial fishing on killer whales	- some continued disturbance of whales while study is underway - minimal changes to fishing while study is underway, changes afterward dependent on study findings
iv)	**form an advisory committee** with agency, public and user group representation, including Native groups	- will help monitor and regulate whale-oriented activity - provide forum for concerns regarding protection of whales and their habitat, fishermen needs, and periodic review of management measures

v)	**improve Marine Mammal regulations and/or whale watching guidelines**	- reduction in whale disturbance if effectively enforced - guidelines to be used for all fishermen - regulations for use in cases of purposeful disturbance - some restriction of vessel movements
vi)	**take steps to prohibit discharge of firearms in reserve**	- reduction of whale disturbance - no impact on fisheries
vii)	**prohibit fishing and/or mooring near the rubbing beaches and/or the Bight**	- reduction in disturbance of whales - loss of mooring rights for fishermen, less effective fishing and some loss of fishing opportunities
viii)	**prohibit fishing and/or mooring in the entire Reserve**	- no disturbance of whales by commercial fishing in the Reserve - loss of fishing opportunities, loss of mooring rights, and less effective fishing
ix)	others?	

Under Options i) - vi), commercial fishing boats would be the only boats allowed in the Reserve, except for in-transit marine traffic such as tugs and freighters. Other boats used for whale watching, recreation, research and photography would be restricted except by permit, as is the current practice. However, the presence of fishing boats may encourage other boaters to enter the Reserve.

8.2.2 Whale watching in Johnstone Strait

Summary of Issue

Outside RBMBER, disturbance of whales by recreational boaters, commercial charters, researchers and photographers is increasing and effective control of these activities is lacking.

OPTIONS	CONSEQUENCES
Whale watching in general	
i) **status quo** for following the whales	- continued disturbance of whales by recreational boaters, commercial charters, researchers and photographers - may result in less whale viewing opportunities - continued unimpeded access to whales for all whale watching groups
ii) **expand existing public education program** to include all potential whale watching groups on the North Island and Vancouver/Victoria areas	- more effective education of whale watchers prior to visiting area and reduced whale disturbance - may eventually increase number of whale watchers and possibly whale disturbance if not combined with other management measures
iii) **establish a DFO seasonal information program** in Johnstone Strait	- reduced disturbance of whales - increased coverage of area for education on whale watching - would complement existing EcoReserve programs - effective implementation of existing or new DFO whale watching guidelines
iv) **develop a land-based whale watching park** on the Strait away from Robson Bight	- focus some of demand for whale watching away from sensitive whale habitat - may reduce vessel disturbance of whales, especially if combined with an educational program
v) **continue research activity** regarding whales and their habitat requirements in Johnstone Strait	- some potential for disturbance to whales - increased understanding of whale behaviour and how it changes in the presence of human activity - better management decisions
vi) **develop a special management area** in Johnstone Strait with levels of zoning for whale watching activity	- to be used primarily as a focus area to educate the public and reduce disturbance of whales by progressively limiting whale watching in approach to Robson Bight
vii) **form an advisory committee** with agency, public and user group representation, including Native groups	- will help regulate and monitor whale watching - provide forum for concerns regarding protection of whales and their habitat, whale watching and periodic review of management measures
viii) **improve Marine Mammal regulations and/or whale watching guidelines**	- reduction in whale disturbance if effectively enforced - guidelines to be used for all whale watchers - regulations for use in cases of purposeful disturbance

Specific to whale watching charters

ix)	**self-policing** by charter association	- reduced disturbance of whales - need to provide appropriate incentives to industry to assist in self-policing
x)	**establish licensing program** with provisions to revoke licence if regular harassment is reported	- reduced disturbance by charters - potentially better education of operators - benefits operators who follow guidelines
xi)	**establish limited entry licensing program** with provisions to revoke licence if regular harassment is reported	- reduced disturbance by charters - demand for whale watching may increase number of recreational boaters - benefits operators who follow guidelines - who is eligible for a licence?

Specific to researchers/photographers

xii)	**renew DFO permit system** for Johnstone Strait	- reduced disturbance by researchers and photographers in killer whale core area - researchers and photographers may depart to less regulated areas of killer whale range - may discourage research or result in inequities between those who require a permit (researchers and photographers) and those who do not (public) unless in combined with other management measures
xii)	others?	

8.2.3 Whale watching in Robson Bight (Michael Bigg) Ecological Reserve

Summary of Issue:

Within RBMBER, whale watching by recreational boaters, charters, researchers and photographers has not resulted in serious disturbance, partially due to education, managementand the full-time presence of ecological reserve information officers. Education has been the most effective tool for reducing disturbance of whales by whale watchers in RBMBER, as the majority of whale watchers stay outside the Reserve once informed of its importance as whale habitat and watch whales elsewhere in the Strait. A permit system is in place, to control the activities of researchers and photographers.

	OPTIONS	CONSEQUENCES
i)	**maintain existing Ecological Reserve boundaries, regulations and programs**, ie. visitor information, research funding, and permit system	- some continued disturbance of whales and reduced opportunities for viewing, research and photography - growth in whale watching may make the current system ineffective, due to lack of enforcement powers for infractions on the water
ii)	**continue research activity** regarding whales and their habitat requirements in RBMBER	- some potential for disturbance to whales - increased understanding of whale behaviour and how it changes in the presence of human activity - better management decisions
iv)	**close part or all the Reserve** to whale watchers, researchers and photographers, except by permit, for period of peak whale occurrence	- reduced or no disturbance of whales in RBMBER due to whale watching activity - loss of some educational value of allowing visitors into Reserve - would clarify enforcement
v)	**DFO to enforce whale watching guidelines in the Reserve or confer Fisheries Act powers to BC Parks**	- would allow more effective monitoring and protection of whales in RBMBER, if Marine Mammal regulations are improved - potential for whale watching activity to shift to less monitored areas
vi)	others?	

8.2.4 Land Access

Summary of Issue:

Killer whales in RBMBER are very sensitive to disturbance while rubbing on the beaches or resting, leaving the area when disturbed by people on shore. However, with only one exception, land access to the reserve has so far resulted from boats landing on shore. Access from land is difficult. In the Tsitika, logging roads are 4 km away from the Bight. However, the Schmidt Creek logging road is adjacent to the reserve, close to the rubbing beaches. Both the Tsitika and Schmidt Creek roads now have gates kilometres away from the reserve. Potential erosion resulting from road building and whale disturbance resulting from unauthorized access, noise and other activities remain as concerns.

	OPTIONS	CONSEQUENCES
i)	**establish a land-based whale watching park** away from RBMBER, for education and provision of well-controlled whale viewing	- may redirect public desire for land access to whales in the Reserve - may limit disturbance from the water if reasonably accessible and if there is effective on-the-water education/enforcement to deter whale harassment
ii)	**continue research** to document effects of human activity on whales	- better management decisions
iii)	**continue road building** and monitoring of gated access in Tsitika and Schmidt watersheds	- road construction, logging access activity and unauthorized access may result in whale disturbance - does not restrict logging access - potential for erosion and sedimentation affecting habitat in the Bight and/or rubbing beaches
iv)	**defer road building** in Tsitika watershed until **research** on access impacts is completed	- may provide additional information to resolve questions regarding access and impacts - restricts logging access temporarily
v)	**discontinue road construction** in the Tsitika drainage and **maintain gated access** in both Tsitika and Schmidt watersheds	- minimizes access and potential for whale disturbance - restricts logging access in the Tsitika valley
vi)	**log by helicopter** in area surrounding the Reserve, especially above the rubbing beaches and the Bight	- no road construction required, thus reducing possible disturbance from land access - potential for noise impacts on whales, if done during period of peak whale occurrence - reduced risk of erosion or sedimentation in the Bight
vii)	**extend the Reserve** eastward to include Schmidt Creek and/or southward behind the Bight	- minor loss of public access - increased protection for whale habitat - loss of logging opportunity
viii)	**improve Ecological Reserve regulations** to better control land access	- minor loss of public access - increased protection for the Bight, rubbing beaches - reduced whale disturbance
ix)	**others?**	

8.2.5 Forest Management

Summary of Issue:

Forest harvesting and associated management activities are occurring in the Tsitika watershed behind the Bight and in Schmidt Creek, directly east of the rubbing beaches. Concern, because of the proximity of these activities to sensitive whale habitat, include the possibility of increased sediments, risk of blowdown, disturbance from logging activities and improved land access. Forestry activities in the Tsitika watershed are controlled by the Tsitika Follow-up Committee but their mandate does not include the Schmidt Creek drainage.

	OPTIONS	CONSEQUENCES
i)	continue **research** on forest practices	- increase understanding of potential blowdown, and selective logging
ii)	**continue logging** in the lower Tsitika watershed under the direction of the TFC and continue logging in Schmidt Ck.	- risk of habitat damage and whale disturbance - status quo logging revenue and jobs - loss of landscape values due to visual impacts
iii)	**include Schmidt Ck.** in TFC mandate with **additional logging restrictions** and monitoring to safeguard whales and their habitat	- reduced risk of habitat damage although logging continues adjacent to the Reserve - some loss of landscape values
iv)	**defer logging** in the lower Tsitika valley and/or Schmidt Ck. until studies on access, sedimentation and whale behaviour are completed	- reduced risk of habitat damage - may provide additional information on impacts to whales and their habitat - restricts logging temporarily
v)	**log by helicopter** in area surrounding RBMBER and especially above the rubbing beaches and the Bight	- no road construction required - noise impacts if logged when whales present - more expensive logging practice - reduced risk of habitat damage
vi)	**extend the Reserve** eastward to include lower Schmidt Ck. and/or southward in Tsitika	- potential loss of logging revenue - minor loss of public access - increased protection for whale habitat
vii)	**increase size of RBMBER** to include visual backdrop in the Tsitika watershed	- minimize risk to whales and habitat - loss of logging revenue - maintain landscape values
viii)	**discontinue logging** in the lower Tsitika and/or the lower Schmidt Ck. drainages	- loss of logging revenue - minimum potential for logging-related or access-related impacts to whales and habitat
ix)	others?	

9.0 PRELIMINARY RECOMMENDATIONS

In areas where there are obvious conflicts between various user groups, or between these groups and the whales, it is difficult for the Committee to make preliminary recommendations without first consulting the public and user groups. Until this is done, management recommendations related to resource management can only be vague. On the other hand, recommendations regarding education, research and legislation can be more detailed as these do not involve user groups to the same extent.

Hence, preliminary recommendations are presented here, to solicit feedback from concerned individuals and groups to assist the committee in determining final recommendations. We fully expect that new and/or modified recommendations will result from the public input process.

9.1 Education

Education is the most powerful tool to protect the whales in Johnstone Strait. Unless users are generally willing to abide by management agreements or legislation, enforcement is impractical or ineffective. The most beneficial factor to killer whales in the past 20 years has been a shift in attitude towards whales by the general public, whale watchers and fishermen alike. Killer whales prior to the 1960s were seen as a nuisance. They are now seen for the magnificent animals they are, and this new awareness has brought positive changes in the behaviour of people who share marine waters with the whales.

However, most negative interactions with the whales still take place out of a lack of awareness rather than maliciousness. Consequently, a broad education program is required to pass on our increasing knowledge and understanding of killer whales to the public.

Specific recommendations for an education program are as follows:

1. A whale watching pamphlet produced by DFO on the East Coast should be revised for the West Coast, and be widely distributed to provide general information on killer whale biology and distribution, and on acceptable whale watching practices along our coastline.

2. B.C. Parks should continue to produce its pamphlet on RBMBER and to distribute it to visitors to this area and to local residents.

3. For at least two years, a education program on killer whales should be organized jointly by Fisheries and Oceans (DFO) and B.C. Parks to present films, slide shows and live presentations in the local communities up island directly involved with these issues.

4. B.C. Parks should maintain its visitor information program at RBMBER during the summer months.

5. B.C. Parks should consider adding an off-site interpretive component to its visitor program during the summer months by giving weekly presentations in campgrounds and other suitable sites around the Telegraph Cove/Port McNeill area.

6. DFO should consider establishing a special education program for Native and non-Native commercial and recreational fishermen along the B.C. coast.

7. B.C. Parks and DFO should jointly establish and manage a whale watching park in western Johnstone Strait, away from Robson Bight.

9.2 Research

Many questions remain unanswered regarding killer whale biology and distribution, the importance of Johnstone Strait and Robson Bight to these whales, and the possible impacts of human activities on the whales and their habitat. Yet, management decisions are made every day that could eventually have much impact on the whales and their habitat, potentially eliminating the unique whale research and viewing opportunities found in Johnstone Strait. Some very basic questions must be answered to preserve these unique opportunities.

Specific recommendations for a research program area as follows:

1. DFO should establish a research fund, including private sector participation, to encourage new killer whale research in Johnstone Strait, and to support long-term research already underway.

2. B.C. Parks should continue to provide research funding to document the impact of human activities on the whales and their habitat in RBMBER.

3. DFO and B.C. Parks should jointly establish a research facility in Johnstone Strait to encourage and provide support to researchers. This facility can also be used by visitor information officers hired by B.C. Parks and possibly DFO, de facto, creating a nucleus of staff/researchers that can readily exchange information on whale movement and behaviour, and human activities affecting whales in the area.

4. Local universities and other groups interested in whale research (Vancouver Aquarium, West Coast Whale Research, etc.) should establish a formal association to promote information exchange among researchers and to identify research needs, and provide advice on research priorities and projects.

9.3 Legislation

Even the best public education program is not enough to control all human activity affecting killer whales. There are always individuals or groups who will ignore established guidelines for a variety of reasons. Appropriate legislation is needed to deal with these exceptions and to demonstrate government determination to protect killer whales and their habitat. An improvement in legislation is required both on the water and on land.

Specific recommendations regarding legislation are as follows:

1. Subsequent to review of current legislation and the Marine Mammal regulations, DFO should consider measures to enable more effective prosecution for harassment of whales.

2. B.C. Parks should improve the Ecological Reserve Regulations to better control human activities on land in RBMBER.

9.4 Resource Management

As stated earlier, recommendations regarding resource management need the collaboration of the people who have a "stake" in the matter. Various resource users as well as the public are joint stakeholders in the Johnstone Strait area. Recommendations from the Killer Whale Committee that do not fully involve these stakeholders are likely to fail. Recommendations per se do not protect whales; people's willingness to participate and to abide by recommendations do.

Consequently, the only major recommendation regarding resource management we can put forward at this point in the process is to establish an Advisory Committee, representing government agencies, the public and the Native and non-Native user groups. This would provide a forum for all to present their point of view and to continue participation in the decision-making process.

The objectives of the Advisory Committee would be to:

1) help implement the recommendations of the Johnstone Strait Killer Whale Committee;
2) periodically review management of Johnstone Strait and RBMBER to ensure that protective measures for killer whales and their habitat remain adequate and effective;
3) recommend new protective measures as required;
4) identify priorities for, encourage and review killer whale research projects for Johnstone Strait; and,
5) take the concerns of the public and Native and non-Native user groups into account.

There is no doubt that decisions need to be made regarding whale watching practices, commercial fishing in RBMBER and logging in areas adjacent to the Reserve. However, these decisions can only be made after public consultation. It is imperative that we obtain broad input on the management options outlined in this report to deal with conflicts between whales and resource users. Also, other options may be put forward by participants to this process. All feasible options will be evaluated prior to finalizing recommendations to B.C. Parks and DFO. This being said, there are basic principles regarding these issues that can be spelled out now.

Access to the Reserve, from land or the water, is probably the single most important issue when it comes to minimizing human impacts on the whales. As access involves all major resource uses, public consultation is needed to adequately address this issue.

Commercial fishing in RBMBER is currently the largest single source of disturbance to the whales, primarily at the rubbing beaches. There is an obvious need to improve this situation. This, however, will be done only after consulting appropriate representatives from the commercial fishing sector.

Impacts related to recreational whale watching can mostly be addressed by the management recommendations already put forward. However, charter whale watching may require other measures. By and large, full-time whale watching charters in Johnstone Strait have been very responsible in remaining outside RBMBER and regarding protection of the whales. To support responsible operations, the current self-regulating system needs formalizing to ensure that high standards are maintained by all operators for appropriate whale watching conduct, especially in areas outside the Reserve.

Finally, a permit system for photographers and researchers in Johnstone Strait needs to be formalized by DFO, in collaboration with BC Parks.

REFERENCES

Alaska Marine Highway. 1990. Ferry schedule. Seattle, Wa.

Association of B.C. Professional Foresters. 1987. **Forest facts about the Port McNeill Forest District**. North Island Regional Public Affairs Committee, ABCPF, 4 p.

Atkins, N, and S. Swartz (eds.) 1988. **Proceedings of a workshop to review and evaluate whale watching programs and management needs.** Sponsored by the Center for Marine Conservation and the National Marine Fisheries Service, Monterey, CA.

Balcomb-Bartok, K. 1990. **Killer whale "rubbing beaches" in Prince William Sound.** Center for Whale Research, Friday Harbor, WA. and North Gulf Oceanic Society. Poster session at the Third International Symposium, Victoria, B.C.

Bigg, M. A., G. M. Ellis, J. K. B. Ford and K. C. Balcomb. 1987. **Killer whales. A study of their identification, genealogy and natural history in British columbia and Washington State.** Phantom Press, Nanaimo, B.C.. 79 p.

Bigg, M. A., G. M. Ellis, J. K. B. Ford and K. C. Balcomb. 1990. **Feeding habits of the resident and transient forms of killer whale in British Columbia and Washington State.** Paper presented at the Third International Symposium, Victoria, B.C.

Blood, D. A., I. B. MacAskie and C. J. Low. 1988. **Robson Bight Ecological Reserve. Background Report.** Report prepared for the Ecological Reserves Program, Victoria by D. A. Blood and Associates Ltd., Nanaimo, B.C.. 51 p. + 19 appendices.

Boas, Franz. 1934. **Geographical names of the Kwakiutl.** Columbia University Press (reprinted in 1969 by AMS Press).

Breton, M. 1990. **Whale observation: the excursion industry reaches cruising speed.** Department of Fisheries and Oceans publication, Quebec Region.

Briggs, D. A. 1986. **Census tables of boat traffic in the Johnstone Strait during the periods July 11 - September 1, 1984 and July 1 - September 1, 1985.** Univ. Calif., Santa Cruz, Calif. 89 p.

Briggs, D.A. 1988. **Usage of the rubbing beaches at Robson Bight Ecological Reserve by whales and boats.** Prepared for the Ecological Reserves Program, Ministry of Environment and Parks, Victoria, B.C.

Briggs, D. A. 1991. **Impact of human activities on killer whales at the rubbing beaches in the Robson Bight Ecological Reserve and adjacent waters during the summers of 1987 and 1989.** Report prepared for the Ecological Reserves Program, Victoria. 25 p.+ app.

Briggs, D.A. (in prep.) **Summary of activities by killer whales and human activities in the Robson Bight Ecological Reserve and adjacent waters during the summer of 1990.** Report prepared for the Ecological Reserves Program, Ministry of Parks, Victoria. 33 p. + app.

Ceska, A. 1981. **Vegetation of the Tsitika River Estuary.** Report submitted by CESKA Geobotanical Research Co., Victoria, B.C. for the Ecological Reserves Program, Victoria. 28 p.

Chatwin, S. and D. Hogan. in press. **Landslides, sediment and channel morphology: management implications for B.C. coastal forestry.** Cdn. Wat. Res. J.

Daniels, A. Vancouver Sun, February 2, 1991.

Darling, J. D 1986. **Robson Bight Ecological Reserve Management Plan. An assessment of human activities on killer whales of the Robson Bight Ecological Reserve with management guidelines.** Report prepared for the Ecological Reserves Program, Victoria by West Coast Whale Research Foundation, Vancouver, B.C. 83 p.

Department of Fisheries and Oceans. 1960. Letter dated July 26 1960.

Department of Fisheries and Oceans. 1990. **EARP Screening Document: Tsitika Watershed Intergrated Resource Plan (TWIRP).** Vancouver, B.C.

Department of Fisheries and Oceans and Environment Canada. 1990. **Interdepartmental Action Plan to Favour the Survival of the St. Lawrence Beluga Whale.** Annual Report 1989-1990. Quebec Region.

Duffus, D. 1988. **Non-consumptive use and management of cetaceans in British Columbia coastal waters.** Ph.D. Thesis, Dept. of Geography, University of Victoria.

Duffus, D, and P. Dearden. 1989. **Non-consumptive use and management of killer whales (Orcinus orca) in Johnstone Strait, British Columbia.** Prepared for World Wildlife Fund Canada. Dept. Geography, Univ. Victoria. 15 p.

Duffus, D. and P. Dearden. 1990. **A perspective on whale-watching and tourism in British Columbia.** Unpubl. Rep., Dep. Geography, Univ. Victoria, B.C. 100 p.

Eldridge, M., S. Zacharias, R. Bouchard, and D. Kennedy. 1988. **Robson Bight archeological resource inventory.** Report submitted to the Archeology and Outdoor Recreation Branch, Ministry of Municipal Affairs, Recreation and Culture. 130 p. + appendices.

Ferrari, M. 1988. An overview of whale watching in Hawaii. in S.L. Swartz. (ed.) **Proceedings of a workshop to review and evaluate whale watching programs and management needs.** Sponsored by the Center for Marine Conservation and the National Marine Fisheries Service, Monterey, CA. 53 p.

Ford, J. K. B. 1984. **Call traditions and dialects of killer whales (Orcinus orca) in British Columbia.** PhD thesis, University of British Columbia, Vancouver, British Columbia. 435 p.

Ford, J.K.B. 1989. Acoustic behaviour of resident killer whales (Orcinus orca) off Vancouver Island, British Columbia. **Cdn. J. Zool.** 67:727-745.

Golding, D.L. 1987. Change in streamflow peaks following timber harvest of a coastal British Columbia watershed. **IAHS-AISH Publ.** No. 167: 509-517.

Harr, R. D. 1986. Effects of clearcutting on rain-on-snow runoff in western Oregon: a new look at old studies. **Water Resources Research** 22(7):1095-1100.

Harvey, L. (in press). **Mount Waddington Community Futures Study.** Prepared for the Mount Waddington Community Futures Committee.

Hay and Company Consultants Inc. (in press) **Shoreline processes and sediment deposition in Robson Bight, Johnstone Strait.** Prepared for the Ministry of Forests Vancouver Region, Vancouver, B.C.

Hetherington, E.D. 1987. **Hydrology and logging in the Carnation Creek watershed - what have we learned?** In: Proceedings of workshop: **Applying 15 years of Carnation Creek results.** T.W. Chamberlain (ed.).

Heyning, J. E. and M. E. Dahlheim. 1988. Orcinus orca, **Mammalian Species** No. 304, pp. 1-9.

Holmsen Forestry. 1985. cited in Eldridge et al. 1988. **Robson Bight archeological resource inventory.** Report submitted to the Archeology and Outdoor Recreation Branch, Ministry of Municipal Affairs, Recreation and Culture.

Hoyt, E. 1990. **Orca: The Whale Called Killer.** Camden House, Camden East, Ontario. 259 p.

Interagency Committee for Outdoor Recreation. 1990. **Assessment and policy plan for outdoor recreation.** Prepared by the Planning Services Division. Tumwater, WA.

Jones, M.L. and S.L. Swartz. 1984. **Demography and phenology of gray whales and evaluation of whale watching activities in Laguna San Ignacio, Baja California Sur, Mexico.** In M.L. Jones, S.L. Swartz, and S. Leatherwood (eds.) **The Gray Whale (Eschrichtius robustus).** Academic Press, Orlando Florida.

Kwakiutl First Nations. no date. Kwakiutl Declaration.

Kruse, S. L. 1984. **The interactions between killer whales and boats in Johnstone Strait, B.C.**. Unpubl. Rep., Univ. Calif., Santa Cruz, Calif. 15 p. + 8 figs.

Lewis, T. 1989. **Robson Bight Ecological Reserve #111: Evaluation of Potential Impacts - Southwestern Boundary.** Prepared for the Ecological Reserves Program, Victoria, B.C.MacMillan Bloedel Ltd. 1990. Five year development and logging plan, TFL No. 39. CP No. 19&20. Eve River Division.

Ministry of Environment. 1981. **Killer whales and coastal log management: an overview of future uses of Robson Bight, British Columbia.** APD Bulletin No. 6. 45 p.

Ministry of Forests. 1990. B.C. Forest Service Review of the Tsitika Watershed. Updated Technical Background (Nov. 1990).

Ministry of Forests. Interdepartmentalmemorandum. February 7 1991.

Mossop, S. 1989. **Northern Vancouver Island: A guide to industry and investment opportunities in the Regional District of Mount Waddington.** Prepared for the Regional District of Mount Waddington.

Mount Waddington Regional District (MWRD). 1986. Community descriptions.

Nichol, L.M. 1990. **Seasonal movements and foraging behaviour of resident killer whales (Orcinus orca) in relation to the inshore distribution of salmon (Oncorhyncus spp.) in British Columbia.** M.Sc. Thesis, University of British Columbia.

National Oceanic and Atmospheric Administration (NOAA). 1987. **Endangered Fish and Wildlife: Approaching Humpback Whales in Hawaiian Waters.** in Federal Register, November 23, 1987. 52(225):44912-44915.

Olesiuk, P., M. A. Bigg and G.E. Ellis. 1990. **Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State.** Rep. International Whaling Commission, Special Issue, 165 p.

Osborne, R. W. 1988. **Whale watching trends and killer whale occurrence in greater Puget Sound.** Presented to NOAA Whale Watching Workshop, Monterey, CA in November 1988. The Whale Museum, Friday Harbor, WA 98250. 17 p. + appendices.

Regional District of Mount Waddington. 1990. **Fishing lodges and resorts on More North Island.** 1 p.

Rennie, F. 1982. **An assessment of the national significance of Robson Bight, British Columbia.** Final Report, Parks System Planning Division, National Parks Branch, Parks Canada, Ottawa. 77 p.

Rice, R.M. 1980. **Cumulative effects of forest management on California watersheds: an assessment of status and need for information.** pp. 36-46 in R. Standiford and S. Ramacher (eds.). 1981. **Proceedings of the Edgebrook Conference**, U.C. Berkeley. 109 p.

Rood, K.M. 1984. **An aerial photograph inventory of the frequency and yield of mass wasting on the Queen Charlotte Islands, British Columbia.** B.C. Min. Forests, Land Manage. Rep. No. 34.

Statistics Canada. 1986. Population data for Mount Waddington Regional District.

Stewart, H. 1984. **Cedar**. Douglas and McIntyre. Toronto.

Spong, P. and H. Symonds. unpubl. data. OrcaLab.

Tassone, B.L. 1987. **Sediment loads from 1973 to 1984 in Carnation Creek at the mouth.** In: Proceedings of workshop: Applying 15 years of Carnation Creek results. T.W. Chamberlain (ed.)

Taylor, R. E. 1988a. **The use of a marine mammal reserve by researchers and photographers.** Research paper, Natural Resource Management Program, Simon Fraser University. 73 p. + appendices.

Taylor, R. E. 1988b. **Visitor program at Robson Bight Ecological Reserve, summer 1987.** Report prepared for Ecological Reserves Program, Victoria. 27 p. + appendices.

Taylor, R. E. and H. J. Parsons. 1989. **Report on 1989 Robson Bight visitor program.** Report prepared for Ecological Reserves Program, Victoria. 22 p. + appendices.

Tilt, W. 1985. **Whales and whale watching in North America with special emphasis on whale harassment.** Yale School of Forestry and Environmental Studies, New Haven, Ct. 110 p. + appendices.

Thomson, R.E. 1981. **Oceanography of the British Columbia coast**. Canadian Special Publication of Fisheries and Aquatic Sciences 56: 291 p.

Toews, D.A. A. and D. Wilford. 1978. **Watershed management considerations for operational planning on T.F.L. #39 (Blk 6A) Graham Island.** Fisheries and Marine Service Report No. 1473.

Vancouver Port Corporation. 1990. Public information publications. Vancouver, B.C.

Vessel Traffic Services. Canadian Coast Guard, September 27 1990.

Western Forest Products. 1991. Five Year Development Plan, TFL No. 25 - CP7 - Naka Creek. Development Plan 1991-1995.

PERSONAL COMMUNICATIONS

Ambers, Verna. Economic development officer, Musgamagw Tribal Council, Alert Bay. September 1990.

Arcese, David. President, Northern Lights Expeditions, Seattle, WA. September 1990.

Balfe, B. Area officer, Navigable Waters Protection, Canadian Coast Guard, Vancouver, B.C. February 1991.

Bekker, P. Manager, Planning and Resource Management, B.C. Ministry of Tourism. January 1990.

Breton, M. Department of Fisheries and Oceans, Quebec Region. April 1991.

Briggs, D. Whale-human impact researcher, Johnstone Strait. September 1990.

Brownlee, M. Department of Fisheries and Oceans, Vancouver, B.C. January 1991.

Cranmer, Roy. Native fisherman, Alert Bay, B.C. December 13 1990.

Duffus, D. Department of Geography, University of Victoria. September 1990.

Ellis, G. Marine Mammal Section, Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, B.C. February 1991

Goulet, L. Systems Planning, Ministry of Parks, Victoria. January 1991.

Guenther, S. Native land claims lawyer, Vancouver, B.C. December 1990.

Hogan, D. Research Geomorphologist, Ministry of Forests, Burnaby, B.C. December 1990.

Leesing, J. Chief Forester, Western Forest Products, Port McNeill Division. December 1990.

Lewis, J. Assistant Area Supervisor, Department of Fisheries and Oceans, Campbell River, B.C. September 1990.

McConnell, D. Coastal geomorphologist, Hay and Company Consultants Inc., Vancouver, B.C. March 1991.

MacKay, B. Stubbs Island Charters, Telegraph Cove, B.C. February 1991.

Osborn, L. Coordinator, Communications and Policy, Outdoor Recreation Council, Vancouver, B.C. September 1990.

Osborne, R. Research Director, The Whale Museum, Friday Harbor, Washington.

ACKNOWLEDGEMENTS

Dr. Michael Bigg was appointed co-chair of the Johnstone Strait Killer Whale Committee in May 1990. He died in October 1990. In spite of his short time with the committee, his contribution was invaluable. Dr. Bigg worked within Fisheries and Oceans to create this committee. He participated in writing the terms of reference and selecting committee members. In addition, he helped produce a first draft of the committee report, which clearly reflects his world-renowned expertise on killer whales. Thanks to Dr. Bigg's work and dedication, this committee is contributing to the protection of killer whales.

Since May 1990, there have been other changes to the committee membership. Mr. Mike Brownlee, previously with the Habitat Management Division of Fisheries and Oceans, contributed with knowledge of logging and fisheries issues in the Tsitika area. Ms. Carol McNichol, previously with the BC Ministry of Native Affairs, ensured that our report accurately identified facts related to native people. Ms. Coleen Davis, our initial assistant, helped organize the committee. All left their mark, generously contributing their time and expertise. We wish to thank them for their help and dedication.

New committee members were added to fill existing gaps. Dr. John Ford, Vancouver Aquarium, and Mr. Graeme Ellis, Fisheries and Oceans, joined the committee in mid-stream, providing their expertise on killer whales. Ms. Robin Taylor was hired as a technical assistant to help write the committee report. Without her skills, knowledge and long working hours, our report would not be the worthy document we believe it is. Finally, Mr. Nicholas May, Native Affairs, and Mr. John Payne, Fisheries and Oceans, recently replaced departing committee members. We thank all of them for accepting this challenge and contributing to the committee's work.

Finally, we thank all other committee members for taking time out of their busy schedules to contribute their expertise to the Killer Whale Committee. In particular, we appreciate their willingness to not only relate their own perspective but to abide by the committee's unspoken rule that each member, regardless of their affiliation, is there to speak "on behalf of killer whales".

Louise Goulet
Co-chair, BC Parks

Ed Lochbaum
Co-chair, Fisheries and Oceans

Appendix 1

Terms of Reference and Membership
Johnstone Strait Killer Whale Committee

Mandate

- *to propose management options*

The goal of the Department of Fisheries and Oceans and of the Ministry of Parks is to ensure that human activities do not discourage killer whales from using Johnstone Strait, and in particular from using the Robson Bight Ecological Reserve.

The mandate of the federal-provincial Johnstone Strait Killer Whale Committee will be to propose management options which take into account the environmental requirements of killer whales in the region and the needs of various human resource users (e.g. whale watchers, loggers, fishermen).

To achieve this mandate, the committee will:

- *assess importance*
- assess the importance of Johnstone Strait and of Robson Bight to killer whales;
- *assess impact*
- assess the impact of human activities on killer whales and their environment;
- *propose options to protect killer whale habitat*
- suggest management options to the federal Minister of Fisheries and Oceans and to the provincial Minister of Parks that will ensure the continued presence of killer whales in Johnstone Strait and at Robson Bight with consideration given to the requirements of the various human resource users.

For the waters outside Robson Bight, only the impact of whale watching activities on killer whales will be examined. However, within Robson Bight, all human impacts (such as whale watching, commercial fishing and logging) on killer whales will be considered. Proposed management options will be restricted to whale watching activities in Johnstone Strait and in the Robson Bight area, and to the protection of killer whale habitat in the Robson Bight area.

Canada British Columbia

News Release/Communiqué

Ministry of Parks — Department of Fisheries and Oceans
FOR IMMEDIATE RELEASE — Monday, May 7, 1990

Johnstone Strait Killer Whale Committee Announced

VANCOUVER — Dave Worthy, Member of Parliament for Cariboo-Chilcotin, on behalf of Federal Minister of Fisheries and Oceans Bernard Valcourt, and British Columbia Parks Minister Ivan Messmer today announced an inter-governmental committee to study killer whales in Johnstone Strait.

"We need to learn everything we can about the effects of human activity on killer whales in Robson Bight and Johnstone Strait," Messmer said. "Robson Bight is one of the few places in the world where killer whales congregate and we must do whatever we can to preserve them."

Worthy said: "This committee will provide a balanced review of the issues associated with Robson Bight, and an opportunity for interested groups to express their concerns. A better understanding of the interaction between killer whales and whale watching activities, logging and commercial fishing in Robson Bight will help ensure protection of the whales and their habitat."

The committee will be jointly chaired by:

Dr. Michael Bigg, Marine Mammal Program, Pacific Biological Station, Department of Fisheries and Oceans;

Dr. Louise Goulet, Manager of Planning and System Policies, BC Ministry of Parks.

(over)

Other members of the committee are:

Dr. Ian McTaggart-Cowan, Committee on Whales and Whaling;

Michael Brownlee, Habitat Management Division, Department of Fisheries and Oceans;

Ed Lochbaum, Associate Area Manager, South Coast Division, Fisheries Branch, Department of Fisheries and Oceans;

Carol McNichol, Manager of Natural Resource Management, B.C. Ministry of Native Affairs;

Pieter Bekker, Manager, Planning and Resource Management, B.C. Ministry of Tourism;

Dr. Dale Seip, Research Wildlife Ecologist, B.C. Ministry of Forests.

The committee will assess the importance of Johnstone Strait and Robson Bight to the killer whales and the impact of human activities on killer whales and their environment. It will also suggest options that will guarantee the continued presence of killer whales in Johnstone Strait and at Robson Bight.

The committee will prepare a background report which will be presented to the public for review and comments. Public meetings will be held in Vancouver, Victoria and Port McNeill.

After receiving public input, the committee will revise its report and circulate it among representative groups for final comment.

The final report is expected to be ready for Ministers Valcourt and Messmer in the new year.

- 30 -

Contact: Ed Wall 356-7045
Ministry of Parks

Bill Morrell 666-0646
Department of Fisheries
and Oceans

JOHNSTONE STRAIT KILLER WHALE COMMITTEE

MEMBERSHIP

Co-Chairs

Mr. Ed Lochbaum
Associate Area Manager,
South Coast Division
Dept. of Fisheries and Oceans (DFO)
Nanaimo, B.C.

Dr. Louise Goulet
Manager, System Planning
and Programming
Ministry of Parks
Victoria, B.C.

Other Members

Mr. Pieter Bekker
Manager, Planning and Resource Management
Ministry of Tourism
Victoria, B.C.

Mr. Nicholas May
Director, Natural Resource Management
Ministry of Native Affairs
Victoria, B.C.

Mr. John Payne
Head, Land Use Unit, Habitat Management
Dept of Fisheries and Oceans
Vancouver, B.C.

Dr. Ian McTaggart-Cowan
Chairman, Committee on
Whales and Whaling
Victoria, B.C.

Mr. Ron Lampard
Strathcona District Manager
Ministry of Parks
Parksville, B.C.

Dr. Dale Seip
Regional Wildlife Ecologist
Ministry of Forests
Burnaby, B.C.

Dr. John Ford
Marine Mammal Curator
Vancouver Public Aquarium
Vancouver, B.C.

Mr. Graeme Ellis
Marine Mammal Researcher
Pacific Biological Station, DFO
Nanaimo, B.C.

Researcher/Co-ordinator

Ms. Robin Taylor
Vancouver, B.C.

For further information contact:

c/o Ministry of Parks
2nd floor, 800 Johnson St.
Victoria, B.C. V8V 1X4
Attn: Johnstone Strait Killer Whale Committee
Committee

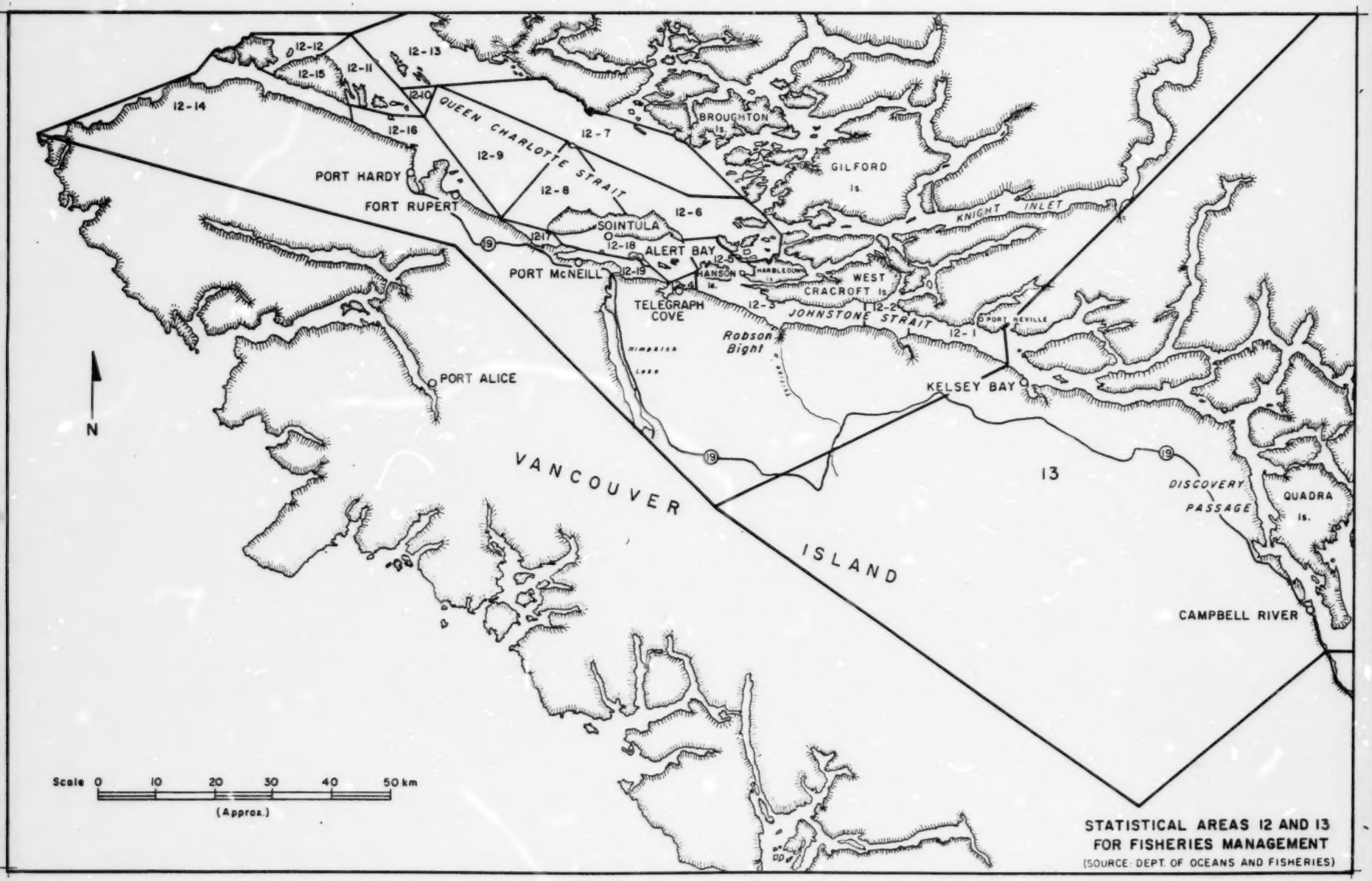
Phone: 387-5002

Department of Fisheries and Oceans
3225 Stephenson Point Road
Nanaimo, B.C. V9T 1K3
Attn: Johnstone Strait Killer Whale

Phone: 756-7270

Appendix 2

Statistical Areas Used for Fisheries Management
(Source: Department of Fisheries and Oceans)



STATISTICAL AREAS 12 AND 13 FOR FISHERIES MANAGEMENT

(SOURCE: DEPT. OF OCEANS AND FISHERIES)

Appendix 3

Robson Bight Ecological Reserve (E.R. #111)
Reports and Publications

111-41A-14 **Anderson, W. 1985.** Nearshore and offshore human activities on Maui humpback waters. Ecology House, the Wharf - Upper Level #166, Lahaina, Maui, Hawaii, 96761. 9 p.

111-4B **Associated Engineering Services Ltd. 1980.** Tsitika River wave study. Report submitted to MacMillan Bloedel Ltd., Nanaimo, B.C. 11 p.

111-1 **Avren, D. n.d.** Canadian law and the grey whale. West Coast Environment Law Association for the Whale Centre, Vancouver, B.C. 13 p.

2243 **B.C. Ministry of Forests. 1990.** Robson Bight Public Meeting, Chairman: The Honorable Claude Richmond. Prepared by Total Reporting Service, April, 1990: 182 p. N.A.

111-33A **B.C. Ministry of Parks. 1989.** Robson Bight Ecological Reserve. pamphlet. Ministry of Parks, Victoria, B.C.

111-9A **B.C. Ministry of Lands, Parks and Housing. 1981.** Robson Bight - Tsitika River Park feasibility study. Planning and Design Branch, Parks and Outdoor Recreation Division, Victoria, B.C. 13 p.

111-20A **B.C. Ministry of Lands, Parks and Housing. 1983.** Robson Bight Ecological Reserve. pamphlet. Ecological Reserves Unit, Ministry of Lands, Parks & Housing, Victoria, B.C.

111-33 **B.C. Ministry of Lands, Parks and Housing. 1986.** Robson Bight ecological reserve. Pamphlet by the Parks Program Branch, Victoria, B.C.

111-9B **B.C. Ministry of Lands, Parks and Housing. 1981.** Robson Bight Summary Report. Ministry of Lands, Parks & Housing, Victoria, B.C. 27 p.

111-23 **Bain, D.E. 1985.** An evaluation of evolutionary process in killer whales (Orcinus orca). Report on study proposal (June to September 1985). University of California, Santa Cruz. 11 p.

1572 **Baird. R. 1990.** "There She Blows". Watching whales in British Columbia. Canadian Warehouse Club Journal 1 (1):7. N.A.

1572A **Baird, R. 1989.** Whales in Georgia Strait and nearby waters - their presence and relative abundance. Discovery 18(4): 131-132. n.a.

1572B **Baird, R., B. Abrams, L. Dill. 1990.** Possible indirect interactions between transient and resident killer whales. Abstract submitted by authors to the Third International Orca Symposium, Victoria, B.C., March 1990.

1572C **Baird, R., L. Dill, Pam Stacey. 1990.** Group size-specific foraging efficiency in transient killer whales (orcinus orca) around southern Vancouver Island. Abstract submitted by authors to the Third International Orca Symposium, Victoria, March 1990. 1 p.

1572D **Baird, R. and Pam Stacey. 1989.** An annotated list of the marine mammals of British Columbia. The Victorian Naturalist 46(2): p. 12-14

94-6 **Baird, R., and P.J. Stacey. 1988** Foraging and feeding behavior of transient killer whales. Whalewatcher, Spring 1988: 11-15.

1580 **Baird, R.W., Pam Stacey, D.A. Duffus, and K.M. Langelier. 1990.** An evaluation of gray whale (Eschrichtius robustus) mortality incidental to fishing operations in British Columbia, Canada. Report prepared for Department of Fisheries and Oceans, Ottawa.

335 **Baird, R.W. and Pam J. Stacey. 1988.** Variations in saddle patch pigmentation in populations of killer whales (Orcinus orca) from British Columbia, Alaska and Washington State. Canadian Journal Zoology 66(11): 2582-2585.

111-14 **Bigg, M.A. 1982.** An assessment of killer whale (Orcinus orca) stocks off Vancouver Island, British Columbia. Rep. Int. Whale Comm. 32:655-666.

111-1A **Bigg, M.A., and A.A. Wolman. 1975.** Live-capture killer whale (Orcinus orca) fishery, British Columbia and Washington, 1962-73. J. Fish. Res. Board Can. 32:1213-1221.

111-3 **Bigg, M.A., I.B. MacAskie, and G. Ellis. 1976.** Abundance and movements of killer whales off eastern and southern Vancouver Island with comments on management. Preliminary report, Arctic Biological Station, Quebec. 20 p.

111-19 **Bigg, M.A., I. MacAskie, and G. Ellis. 1983.** Photo-identification of individual killer whales. Whalewatcher, Spring 1983:3-5.

111-48 **Bigg, M.A., G.M. Ellis, J.K.B. Ford, K.C. Balcomb. 1987.** Killer whales; a study of their identification, geneology, and natural history in British Columbia and Washington State. Produced by West Coast Whale Research Foundation, Vancouver, British Columbia. Phantom Press and Publishers Inc., Nanaimo, B.C. 79 p.

* 111-56 **Blood, D.A., I.B. MacAskie, and C.J. Low. 1988.** Robson Bight Ecological Reserve - Background report. Prepared by D.A. Blood and Associates, for B.C. Ecological Reserves Program, Ministry of Environment and Parks, Victoria, B.C. 96 p.

111-24 **Briggs, D.A. 1985.** Report on the effects of boats on the orcas in the Johnstone Strait from July 11, 1984 - September 1, 1984. University of California, Santa Cruz, CA. 58 p.

111-40 **Briggs, D.A. 1986.** Census tables of boat traffic in the Johnstone Strait during the periods July 11 - September 1, 1984, and July 1 - September 1, 1985. University of California at Santa Cruz, California. 79 p.

* 111-42 **Briggs, D.A. 1987.** Census tables of boat traffic in the Johnstone Strait during the periods July 11 - September 1, 1984 and July 1 - September 1, 1985. University of California at Santa Cruz, California. 89 p.

* 111-52 **Briggs, D.A. 1988.** Usage of the rubbing beaches at Robson Bight Ecological Reserve by whales and boats. Report prepared for Ecological Reserves Program, Victoria, B.C. 66 p.

111-5 **Brooks, D.B., and D. McMullan. 1980.** The trade-off: In the conflict between ever-increasing consumption and declining standard of living, something's got to give. Nature Canada, January - March 1980: 34-38.

Brownlee, M. 1980. Preliminary results of a baseline study of the lower Tsitika River and estuary, May, June, and July, 1979. Habitat Protection Division, Fisheries and Oceans, Canada, Vancouver, B.C.

1572E **Calambokidis, J., K. Langelier, Pam Stacey, R. Baird. 1990.** Environmental contaminants in killer whales from Washington, British Columbia, and Alaska. Abstract submitted by authors to the Third International Orca Symposium, Victoria, B.C., March, 1990.

111-41A-5 **Canada Fisheries and Oceans. n.d.** Watching whales without harassment. Resource Allocation Branch, Fisheries and Oceans, Quebec Region 901, Cap Diament, Quebec City, P.Q. G1K 7Y7. Pamphlet.

111-41A-15 **Canada Fisheries and Oceans. 1960.** Notes of meeting re: Blackfish control in the Discovery Passage. Dept. of Fisheries and Oceans, Nanaimo, B.C. 14 p.

111-20 **Canada Fisheries and Oceans. 1983.** Watching whales. Communication Directorate. Ottawa. Ministry of Supply and Services. FS 23-48/ 1983E. 23 p.

111-41A-13 **Canada Fisheries and Oceans. 1986.** Sommaire du plan de conservation cetaceans St. Laurent, 1986. P. et O., Region de Quebec 901, Cap-Diamont, Quebec, G1K 7Y7. 3 p. plus 3 maps.

111-15 **Carson, R. 1982.** Showdown at Robson Sight: killer whales survived human fear for centuries. Surviving human love may be a different story. Pacific Northwest, November 1982: 26-33.

111-10 **Ceska, A. 1981.** Vegetation of the Tsitika River Estuary. Report submitted by CESKA Geobotanical Research Co., Victoria, B.C., to the Ecological Reserves Program, Victoria, B.C. 28 p.

111-41A-12 **Consiglieri, L.D., and E.T. Nitta. n.d.** Humpback whale management plan for Hawaiian waters. Western Pacific Program Office, S.W. Region, National Marine Fisheries Service, NOAA, Honolulu, Hawaii, 96812. 18 p.

111-41A-11 **Darling, J.D. 1984.** Application for permit for scientific research under the Marine Mammal Protection Act, and scientific purposes under the Endangered Species Act. Measuring and recording photographically identified humpback whales (Megaptea novaeangliae): an hypothesis test on the mating system and song function of the Hawaiian Humpback Whale. West Coast Whale Research Foundation, 1040 West Georgia Street, Vancouver, B.C. 13 p.

111-36 **Darling, J.D. 1986.** Robson Bight Ecological Reserve management plan phase 1. An assessment of the impacts of human activities on the killer whales of Robson Bight Ecological Reserve. West Coast Whale Research Foundation, Vancouver, B.C. 68 p.

111-41 **Darling, J.D. 1986.** An assessment of the impacts of human activities on the killer whales of Robson Bight Ecological Reserve with management guidelines. West Coast Whale Research Foundation, Vancouver, B.C. 83 p. with appended literature.

111-41A-10 **Division of Aquatic Resources. 1981.** Scientific collecting permit application. Dept. of Land and Natural Resources, Div. of Aq. Res., 1151 Punchbowl Street, Room 330, Honolulu, Hawaii, 96813. 2 p.

1577 **Duffus D. and Dearden P. 1989.** Non-consumptive use and management of killer whales (orincus orca) in Johnstone Strait, British Columbia. Prepared for World Wildlife Fund Canada Report, December, 1989, by Department of Geography, Univerisity of Victoria: 16 p.

111-45 **Duffus, D. 1987.** Robson Bight: reserve for killer whales. Park News 22(4):15-17.

111-25 **Duffus, D., and P. Dearden. 1985.** Strategies for research into non-consumptive use and management of cetaceans on the British Columbia coast. Study proposal. Dept. of Geography, University of Victoria. 5 p.

111-46 **Duffus, D., and P. Dearden. 1987.** Non-consumptive use and management of whales, Robson Bight Study Area, 1986. A preliminary report. Department of Geography, University of Victoria. 40 p.

111-41A-16 **Fiesta Escorted Holidays. 1986.** Whale watching excursions. Wayfarer Holidays Limited, 73 Water Street, Vancouver, B.C. V6B 1A1. 28 p.

* 111-0 **Fish and Wildlife Branch, Nanaimo. 1972.** Tsitika River Drainage check sheet. (I.B.P. 111). Conservation of Terrestrial Biological Communities, International Biological Programme. 18 p. incl. app.

111-( ) **Ford, J.K.B. 1980.** Acoustic behaviour of killer whales off eastern and southern Vancouver Island. Dept. of Zoology, University of British Columbia.

111-( ) **Ford, J.K.B. 1981.** Data and comments on the use by killer whales of the Robson Bight and northern Johnstone Strait Areas. Dept. of Zoology, University of British Columbia.

111-37 **Ford, J.K.B. 1986.** Acoustic traditions of killer whales. Discovery 15(2):46-50. (reprinted from Whale Watcher 19(3):3-6).

111-16 **Ford, J.K.B., and H.D. Fisher. 1982.** Killer whales (Orcinus orca) dialects as an indicator of stocks in British Columbia. Report Int. Whale Comm. 32:671-679.

111-( ) **Ford, J.K.B., and H.D. Fisher. 1983.** Group-specific dialects of killer whales (Orcinus orca) in British Columbia. In: R. Payne (ed.). Communication and behaviour of whales. Westview Boulder. pp. 129-162.

111-11 **Ford, J.K.B., and Deborah Ford. 1981.** The killer whales of B.C. Waters. Journal of the Vancouver Aquarium 5(1):1-32.

111-3A **Forest Resource Consultants Limited. 1979.** Evaluation of potential booming and barge loading sites in the vicinity of Tsitika River. Report submitted to MacMillan Bloedel Limited, Sayward, B.C. 30 p.

111-41A-1 **Foster, L. n.d.** The gray whale. American Cetacean Society, P.O. Box 2639, San Pedro, CA, 90731. 2 p.

111-4 **Habitat Protection Division. 1979.** Preliminary results of a baseline study of the lower Tsitika River and Estuary, May, June and July, 1979. Resource Services Branch, Dept. of Fisheries and Oceans, Canada. 26 p.

111-2 **Hoyt, E. 1975.** Killer whales. Westworld, November/December 1975. 4 p.

111-7 **Hoyt, E. 1980.** Whales at bay: the bay called Robson Bight is haven for over half of B.C.'s orcas. But it's in danger. B.C. Outdoors, November 1980:23-24.

111-22 **Hoyt, E. 1984a.** The whales called "killer". National Geographic 166(2):220-237.

111-22A **Hoyt, E. 1984b.** Whales in touch. Beautiful British Columbia magazine 25(4):4-15.

111-22B **Hoyt, E. 1984.** Killer whale: ignoring the rules. In: The Whales of Canada: an Equinox wildlife handbook. Camden House Publishing, Camden East, Ontario. pp. 96-102.

111-( ) **Jacobsen, J. 1980a.** The behaviour of the killer whales (Orcinus orca) in the Johnstone Strait, B.C. Presented at Orca Symposium, American Cetacean Society, Seattle, Wash.

111-( ) **Jacobsen, J. 1980b.** The birth of a killer whale (Orcinus orca) in the Jobnstone Strait, B.C. Presented at Orca Symposium, American Cetacean Society, Seattle, Wash.

111-41C **James Dobbin Associates Incorporated. 1983.** Channel Islands national marine sanctuary management plan. Prepared for: U.S. Department of Commerce, National Oceanic and Atmospheric Administration Sanctuary Programs Division, under contract no. 81-ABC-00209. 69 p. plus appendices.

111-26 **Jacobsen, J. 1985a.** Social structure within pods of killer whales (Orcinus orca) in the Johnstone Strait, British Columbia. Study proposal (continuation) for M.Sc. Thesis. Dept. of Biological Sciences, Humboldt State University, Arcata, Calif. 2 p.

111-27 **Jacobsen, J. 1985b.** Respiratory patterns during rest and sleep of the killer whales (Orcinus orca) in the Johnston Strait, British Columbia. Study proposal (continuation). Dept. of Biological Sciences, Humboldt State University, Arcata, Calif. 2 p.

111-27A **Jacobsen, J. 1985c.** Respiratory patterns during rest and sleep of wild killer whales (Orcinus orca). Poster presentation at Sixth Biennial Conf. on Biology of Marine Mammals, Vancouver, B.C. Nov. 22-26, 1985. 10 p.

111-53 **Jacobsen, J. 1988.** Phototrix 2 - a photogrammetric method for measuring the distance to an object and the size of that object. Unpublished report, P.O. Box 4492, Arcata, Ca. 8p.

111-60 **Jacobsen, J. 1990.** Association and social behavior among killer whales (orincus orca) in the Johnstone Strait, British Columbia, 1979-1986. M.Sc. Thesis Humboldt State University, California. 106 p. + appendix.

1572G **Jefferson, T. P. Stacey, and R. Baird. 1990.** A review of killer whale interactions with other marine mammals: predation to co-existence. Abstract submitted by authors to the Third International Orca Symposium, Victoria, B.C. March 1990.

111-41A-17 **Kruse, S.L. 1984.** The interactions between killer whales and boats in Johnstone Strait, B.C. University of California, Santa Cruz. First draft. 15 p. plus 8 figures.

111-30A **Kruse, Susan L. 1985.** Movements of killer whales in Johnstone Strait, B.C. In: Sixth Biennial Conference on the biology of marine mammals Abstracts, by Society for Marine Mammalogy, 1985. Nov. 22-26, 1985, Vancouver Aquarium, Vancouver, B.C. 8 p.

111-8 **Lee, J., G. Ainscough, P. Moore, and B. Gates. 1980.** Transcription of CJOR radio interview: Robson Bight killer whale issue, Friday, December 19, 1980. Transcribed by Assessment Branch, Ministry of Environment, Victoria, B.C. 15 p.

111-41A-18 **McCloskey, M. 1983.** Recreational whale watching. Prepared for Global Conference on the non-consumptive utilization of cetacean resources. Boston, Mass. June 1983 by Whale Center, 3929 Piedmont Ave., Oakland, CA, 94610. 20 p.

111-41A-19 **McCloskey, M., and M.J. Palmer. 1985.** Suggested functions and benefits of a whale watching trade association. Whale Center, 3929 Piedmont Ave., Oakland, CA, 94611. 2 p.

111-41A-4 **McKenzie, T.P., and M.R. Cox. 1985.** Whales of the Gulf of Maine. National Marine Fisheries Science, Northeast Region, 14 Elm Street, Gloucester, Maine, 01930. 2 p.

111-4A **MacMillan Bloedel Limited. 1979.** Study of booming alternatives for timber in the lower Tsitika drainage. Report prepared for Tsitika Follow-up Committee. 27 p.

111-55 **Minakuchi, H. 1987.** Orca. Anima:72-91.

111-28 **Morton, Alexandra. 1985.** The development of an ethogram for the Northern Vancouver Island Orcinus orca during the Fall, Winter and Spring. Report prepared for Cetus Magazine. 2 p.

111-34 **Morton, Alexandra. 1986 (in prep.)** A preliminary report on transient Orcinus orca behaviour and acoustics in British Columbia waters. Draft report submitted to Ecological Reserves Program, Victoria, B.C. by Lore Quest Society, Victoria, B.C. 9 p.

111-21 **Morton, Alexandra, J.C. Gale, and Renee C. Prince. 1983.** Sound and behaviour correlations. In: Captive Orcinus orca. Chapter 13. 25 p.

111-17 **Morton, R.A. 1982.** Encounters with the killer whale: studies of Orcinus orca behaviour in the wild. Explorers Journal, June 1982:54-61.

111-41B **Nakamura, K. 1985.** Killer whales, Johnstone Strait, Canada. Diving World, No. 123, November 1985:72-79.

111-41A-2 **National Marine Fisheries Service. 1979.** The humpback whale. Western Program Office, National Marine Fisheries Service, P.O. Box 3830, Honolulu, Hawaii, 96812. 2 p.

111-41A-3 **National Marine Fisheries Services. 1980.** The California gray whale. National Marine Fisheries Service, Southwest Region, 300S Ferry Street, Terminal Island, California, 90731. 2 p.

111-41A-9 **National Marine Fisheries Service. 1981.** N.M.F.S. application instructions for Marine Mammal Protection Act, Endangered Species Act, Fur Seal Act Permits. Assistant Administrator for Fisheries, N.M.F.S., Washington, D.C., 20235. 25 p.

111-41A-6 **National Marine Fisheries Service. 1984.** Peak season for whale watching. National Marine Fisheries, SW Region, 300S Ferry Street, Terminal Island, CA, 90731. 1 p.

* 111-41A-8 **National Marine Fisheries Service. 1985.** Northwest region whale watching guidelines. Northwest region, 7600 Sand Point Way, NE Seattle, Washington, 98115. 2 p.

111-41A-20 **Osborne, R. 1986.** Letter regarding whale watching in the San Juan Islands. The Whale Museum, P.O. Box 945, Friday Harbour, Washington, 98250. 2 p.

111-22C **Payer, C., and Mimi Breton. 1984.** Etude socio-economique sur l'industrie d'observation des baleines au Quebec (resume). Recherche effectuee pour la gestion des peches. Direction Generale du Quebec. Ministere des peches et des oceans. Gouvernement du Canada. 34 p.

111-29 **Penny, M., and J. Foot. 1985.** Killer whale project. Summary outline of film to be produced by Survival Anglia, London, England. 4 p.

111-39 **Pynn, L. 1986.** Watching the whale watchers. In "A question of access", Western Living 16(11):117-119.

111-30 **Ramband, P. 1985.** A chacun sa baleine! L'Actualite, Juillet 1985:31-32.

111-18 **Rennie, Frances. 1982.** An assessment of the national significance of Robson Bight, British Columbia. Final report, Parks System Planning Division, National Parks Branch, Parks Canada, Ottawa. 77 p.

111-6 **Robson Bight Preservation Committee of the Top Island Econauts Society. 1980.** The Lower Tsitika River and Robson Bight area: an inventory of salmonid and marine resources. Report submitted to Fisheries and Oceans, and B.C. Fish and Wildlife Branch, Victoria, B.C. 67 p.

* 111-12 **Robson Bight Study Team. 1981.** Killer whales and coastal log management: an overview of future uses of Robson Bight, British Columbia. Assessment and Planning Division, B.C. Ministry of Environment, APD Bulletin No. 6. 31 p. plus appendices.

* 111-0B **Roemer, H.L. 1973.** Addition to the Tsitika River Drainage Report #111 check sheet. Conservation of Terrestrial Biological Communities, International Biological Programme. 18 p. incl. app.

* 111-0A **Roemer, H.L., and I. Smith. 1979.** Tsitika Watershed, parts 1 to 7 (Robson Bight #1) check sheet. (I.B.P. #111.1 to #111.7). Conservation of Terrestrial Biological Communities, International Biological Programme. 16 p. incl. app.

111-51 **Rose, Naomi A. 1988.** Group living in the killer whale: mitigating the costs. A thesis proposal, University of California, Santa Cruz, California. 12 p.

111-38 **Rowles, Diana. 1986.** The prince of whales. B.C. Outdoors, August 1986:24-26.

* 3350 **Runka, G., April Mauer, R. Careless, and K. Youds. 1988.** Wildlife viewing in British Columbia: the tourism potential. Report prepared by Ethos Consulting, Land Sense Ltd., and Youds Planning Consultants for B.C. Wildlife Viewing Tourism Committee, Victoria, B.C. 89 p.

111-13 **Sierra Club of Western Canada. 1981.** Tsitika Provincial Park - Robson Bight Ecological Reserve No. 111: a brief in support of their establishment. Report submitted to the Minister of Lands, Parks, and Housing, Victoria, B.C. 29 p.

111-50 **Smith, Dawn, and Christi Bricknell. 1987.** Human influences on Orcinus orca within Johnstone Strait. Research reports for course E.S. 195, Colleges 8 and Cowell College, University of California, Santa Cruz. Ca. 31 p.

111-30A **Society for Marine Mammology. 1985.** Sixth Biennial Conference on the biology of marine mammals. Abstracts. Nov. 22-26, 1985. Vancouver Aquarium, Vancouver, B.C. 8 p.

3356 **Stacey, Pam J. and R.W.. Baird. 1989.** Harbour seal reactions to killer whales. Victoria Naturalist 45(4): 16,17.

1572F **Stacey, Pam J., R.W. Baird, A.B. Hubbart-Morton. 1990.** transient killer whale (Orincus orca) harassment, predation and "surplus killing" of marine birds in British Columbia. Prepared for the Pacific Seabird Group Annual Meeting 1990. Royal B.C. Museum, Victoria, B.C.

111-30A **Symonds, Helena K., P. Spong, and D. Briggs. 1985.** Incidence of Orcinus orca in the Johnstone Straits Region in 1985. In: Sixth Biennial Conference on the biology of marine mammals. Abstracts by Society for Marine Mammalogy, 1985. Nov. 22-26, 1985. Vancouver Aquarium, Vancouver, B.C. 8 p.

111-49 **Taylor, Robin E. 1988a.** Visitor Program at Robson Bight Ecological Reserve, summer 1987. Report prepared for the Ecological Reserves Program, Ministry of Environment and Parks, Victoria, B.C. 28 p. plus app. and field diary addendum (Ref. no. 111-49A).

111-47 **Taylor, Robin E. 1988b.** The use of a marine mammal reserve by researchers and photographers. Research report for Master of Natural Resource Management, Simon Fraser University. 41 p. plus appendices.

111-58 **Taylor, Robin E., and H.J. Parsons. 1989.** Report on 1989 Robson Bight Visitor Program. Prepared by BUFO Inc., Vancouver, B.C., for Ministry of Parks, Strathcona Zone, Black Creek, B.C. 22 p. + app.

111-32 **Tilt, W.C. 1985.** Whales and whale watching in North America with special emphasis on whale harassment. Yale School of Forestry and Environment Studies, New Haven, Ct. 110 p. plus appendices.

111-9 **Tooze, Zena, J. 1980.** Wilderness playground?: Robson Bight as a focal point for the killer whales off eastern Vancouver Island. Report submitted to the Ecological Reserves Program, Victoria, B.C. 20 p.

111-41A-7 **The Whale Museum. n.d.** Whale watching regulations. P.O. box 945, Friday Harbour, Washington, 98250. 1 p.

111-31A **West Coast Whale Research Foundation. 1985.** West coast whales. Vancouver, B.C. 8 p.

111-14A **Wood, G.A. 1981.** Notes on planning considerations for the lower Tsitika watershed. Victoria, B.C. 13 p.

111-18A **Wood, G.A. 1982.** Robson Bight: where killers dwell. Sierra 67(5): 37-41.

111-43 **Wood, G.A., and M.E. Kay Wood. 1986.** The Tsitika-Robson Bight wilderness issue; a submission to the Wilderness Advisory Committee at Nanaimo, B.C., Jan. 22, 1986. Victoria, B.C., V8X 2B8. 15 p.

111-31 **World Wildlife Fund Canada. 1985.** Whaling ban showdown. WWF News 6(22): 10.

111-59 **Zimmerman, J. 1984.** A behavioral study of Orcinus orca in Johnstone Strait, British Columbia. Department of Biological Sciences, Humboldt State University, Arcata, CA. 16 p.

T111-2 **Anonymous. 1973.** In the mountain meadows the beer cans slowly rust. British Columbia Lumberman, July 1973:41-44.

T111-7 **Anonymous. 1978.** Vancouver Island committee to oppose logging of Tsitika Valley. Press release, February 22, 1978. 2 p.

T111-15 **B.C. Fish and Wildlife. 1979.** Tsitika Estuary birds and mammals inventory: terms of reference. Report submitted to Tsitika Follow-up Committee. 4 p.

T111-1 **B.C. Ministry of Forests. n.d.** Tsitika resource management plan: public involvement opportunity. Pamphlet. Victoria, B.C. 1 p.

T111-8 **B.C. Ministry of Forests. 1978.** The Tsitika integrated resource plan - script. Report submitted to the Ecological Reserves Program, Victoria, B.C. 19 p.

T111-9A **B.C. Ministry of Lands, Parks and Housing. 1981.** Robson Bight - Tsitika River Park feasibility study. Planning and Design Branch, Parks and Outdoor Recreation Division, Victoria, B.C. 13 p.

T111-20 **B.C. Parks and Outdoor Recreation. 1985.** Robson Bight Ecological Reserve upland extension. Ministry of Lands, Parks and Housing, Victoria, B.C. 10 p.

Barichello, N.L. 1975. Habitat selection of blacktailed deer in the Tsitika watershed of Vancouver Island. B.Sc. Thesis, University of British Columbia.

* 111-56 **Blood, D.A., I.B. MacAskie, and C.J. Low. 1988.** Robson Bight Ecological Reserve - Background report. Prepared by D.A. Blood and Associates, for B.C. Ecological Reserves Program, Ministry of Environment and Parks, Victoria, B.C. 96 p.

T111-3 **Canadian Forest Products. 1974.** Management plan for the integrated resources of the Upper Claude Elliott and Tsitika watersheds. Report submitted by Englewood Logging Division, to the North Island Study Task Force. 67 p.

T111-4 **Canadian Forest Products. 1975a.** Management plan for the integrated resources of Schoen Creek area. Report submitted by Englewood Logging Division, to the North Island Study Task Force. 13 p.

T111-5 **Canadian Forest Products. 1975b.** Position paper on Tsitika - Schoen resources study. Report submitted by Englewood Logging Division to the B.C. Environment and Land Use Committee, Victoria, B.C. 12 p.

T111-10 **Ceska, A. 1981.** Vegetation of the Tsitika River Estuary. Report submitted by CESKA Geobotanical Research Co., Victoria, B.C., to the Ecological Reserves Program, Victoria, B.C. 28 p.

T111-( ) **Chamberlin, T., K. Bond, M. Brownlee, and J. Lamb. 1975.** Biophysical stream survey of the Upper Tsitika River. Technical Report Series No. PAC/T-75-7.

T111-23 **Chatwin, S.C. 1985.** Tsitika River Watershed terrain stability. Initial report in 1982, revised by T.P. Rollerson, 1985. Prepared by Land Use Planning Advisory team for MacMillan Bloedel Ltd., Woodland Service Division, Nanaimo, B.C. 9 p.

T111-( ) **Davies, R.B. 1974.** Ungulate Survey of the Nisnak - Schoen, 1974. B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C. Unpublished report.

T111-26 **Eldridge, M., Sandra Zacharias, R. Bouchard, and Dorothy Kennedy. 1988.** Robson Bight archeological resource inventory. Report submitted to Archeology and Outdoor Recreation Branch, Ministry of Municipal Affairs, Recreation and Culture by Millenia Research, Sideny, B.C. 137 p. + 5 maps.

Ellis, R.M. 1974. Habitat selection and distribution of ungulates on Vancouver Island: a comparison. B.S.F. Thesis, University of British Columbia.

T111-6 **Federation of B.C. Naturalists. 1975.** Submission to the Environment and Land Use Committee respecting disposal and use of the Tsitika-Schoen area. Report submitted to the B.C. Environment and Land Use Committee, Victoria, B.C. 4 p.

T111-0 **Fish and Wildlife Branch, Nanaimo. 1972.** Tsitika River Drainage check sheet. (I.B.P. #111). Conservation of Terrestrial Biological Communities, International Biological Programme. 18 p. incl. app.

T111-9 **Gregson, M. 1978** Decision on the Tsitika. ForesTalk, Spring 1978:21-24.

T111-4 **Habitat Protection Division. 1979.** Preliminary results of a baseline study of the lower Tsitika River and Estuary, May, June and July, 1979. Resource Services Branch, Dept. of Fisheries and Oceans, Canada. 26 p.

T111-( ) **Harestad, A., G. Jones, and M. Poe. 1975.** Wildlife observations during winter and the Claud Elliot region of the Tsitika River. B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C. Unpublished report.

T111-23A **Holmes, S.R. 1985.** An analysis of windthrow along clearcut boundaries in the Tsitika watershed. B.S.F. Thesis, University of British Columbia. 104 p.

T111-21 **Holmsen Forestry Ltd. 1985.** Tsitika watershed proposed timber exchange between the province of British Columbia and MacMillan Bloedel Ltd.: appraisal report (TFL37). Report prepared for B.C. Ministry of Lands, Parks and Housing, Victoria, B.C. 62 p.

T111-22 **Holmsen Forestry Ltd. 1985.** Tsitika watershed proposed timber exchange between the province of British Columbia and MacMillan Bloedel Ltd.: appraisal report (TFL39). Report prepared for B.C. Ministry of Lands, Parks and Housing, Victoria, B.C. 131 p.

T111-( ) **Jones, G.W. 1978.** Claud Elliot Wildlife survey. Canadian Forest Products Limited.

T111-24 **Karanka, E.J., and Associates. 1985.** Tsitika River Survey Project - 1985. Survey Program. Report prepared for Habitat protection Unit, B.C. Fisheries Branch, Nanaimo, and Canada Dept. of Fisheries and Oceans. 20 p. plus figures, Plates, Appendices.

T111-25 **Karanka, E.J. and Associates. 1987.** Tsitika River Survey Project - 1986. Hydrology report prepared for the Tsitika Watershed Follow-up Committee. May 1987. 19 p. + plates.

T111-29 **Karanka, E.J. and Associates. 1990.** Tsitika River Survey Program (is being catalogued by main library). Card will be forwarded to us for our bibliography.

T111-27 **Lewis, T. 1989.** Robson Bight Ecological Reserve #111. Evaluation of potential impacts - southwestern boundary. Report prepared for Ecological Reserves Program, Ministry of Parks, Victoria, B.C. 34 p. maps appended.

T111-17A **Lindsay, D.J. 1979.** Claude-Elliot deer pellet plots - 1979. Report submitted by Canadian Forest Products, Vancouver, B.C. to Environmental Land Use Committee Secretariat. 7 p.

T111-( ) **Lindsay, K., and S. Fleck. 1975.** An estimate of the death age distribution of the Tsitiksa River blacktailed deer population by analysis of teeth cementum layers. B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C. Unpublished report.

T111-1A **Moir, B.C., and G. Purchase. 1972.** Preliminary results on the wildlife investigations in the Upper White River watershed, Summer 1972. B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C. Revised report. 102 p.

T111-16 **Moir, B.C. 1979a.** Interim wildlife report: Tsitika River. Woodland Services, MacMillan Bloedel Ltd. 20 p.

T111-17 **Moir, B.C. 1979b.** Deer Report - Tsitika River. Report submitted by MacMillan Bloedel Ltd. to the B.C. Environment and Land Use Committee, Victoria, B.C. 41 p.

T111-25A **Nature Trust of B.C. 1987.** Land acquisition at Robson Bight on northern Vancouver Island, British Columbia. 909-100 Park Royal S. West Vancouver, B.C. V7T 1A2

T111-6A **North Island Study Group. 1973.** Tsitika-Schoen resources study. Technical Report Volume I and Appendices Volume II. Report prepared for B.C. Environment and Land Use Committee. 48 p. + appendices.

T111-6B **North Island Study Group. 1975.** Tsitika-Schoen resources study: summary report. Report prepared for B.C. Environment and Land Use Committee. 43 p.

T111-10 **Orton, D. 1978a.** Report to the member clubs of the Federation of B.C. Naturalists (Vancouver Island region) on the work of "The Committee to extend the Moratorium on logging of the Tsitika Watershed". Letter by the Federation of the British Columbia Naturalists. 9 p.

T111-11 **Orton, D. 1978b.** Lessons from the Tsitika. The Federation of B.C. Naturalists Newsletter 16(4):8-11.

T111-( ) **Reid, Collins and Assoc. 1985.** Western Forest Products reconnaissance cruise. Report prepared for B.C. Ministry of Lands, Parks and Housing, Victoria, B.C. Project no. 52219. 24 p.

T111-( ) **Reimer, D., and P. Kofoed. 1978.** Analysis of Tsitika River - Schoen Lake contributions to the local and provincial economies. MacMillan Bloedel Limited, Woodlands Services, Nanaimo, B.C.

T111-0A **Roemer, H.L., and I. Smith. 1979.** Tsitika Watershed, parts 1 to 7 (Robson Bight #1) check sheet. (I.B.P. #111.1 to #111.7). Conservation of Terrestrial Biological Communities, International Biological Programme. 16 p. incl. app.

T111-0B **Roemer, H.L. 1973.** Addition to the Tsitika River Drainage Report #111 check sheet. Conservation of Terrestrial Biological Communities, International Biological Programme. 18 p. incl. app.

T111-2A **Roemer, H. 1973.** Tsitika Watershed: Ecology. Report prepared for Dr. V.J. Krajina, University of British Columbia. Addendum to Ecological Reserve application No. 111. 11 p.

T111-0A **Roemer, H.L. & I. Smith. 1979.** Tsitika Watershed, parts 1 to 7 (Robson Bight #1) check sheet. (I.B.P. #111.1 to #111.7). Conservation of Terrestrial Biological Communities, International Biological Programme. 16 p. incl. app.

T111-13 **Sierra Club of Western Canada. 1981.** Tsitika Provincial Park - Robson Bight Ecological Reserve No. 111: a brief in support of their establishment. Report submitted to the Minister of Lands, Parks, and Housing, Victoria, B.C. 29 p.

T111-( ) **Smith, I.D., and R. Davies. n.d.** A preliminary investigation of the characteristics of deer and elk range in the Tsitika River Watershed, Vancouver Island. B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C. Unpublished report.

1572f **Stacey, Pam J., R.W. Baird, A.B. Hubbart-Morton. 1990.** transient killer whale (Orincus orca) harassment, predation and "surplus killing" of marine birds in British Columbia. Prepared for the Pacific Seabird Group Annual Meeting 1990. Royal B.C. Museum, Victoria, B.C.

T111-18 **Tsitika Follow-up Committee. 1982.** Tsitika plan implementation procedure. Report submitted to the B.C. Environmental and Land Use Committee, Victoria, B.C. 18 p.

T111-19 **Tsitika Follow-up Committee. 1983.** Tsitika plan status report 1982. Report submitted to the B.C. Environment and Land Use Committee, Victoria, B.C. 72 p.

T111-12 **Tsitika Planning Committee. 1978a.** Tsitika watershed integrated resource plan: summary report. Volume II. Report submitted to the B.C. Environment and Land Use Committee, Victoria, B.C. 67 p.

T111-13 **Tsitika Resource Planning Committee. 1978b.** Tsitika resource management plan: public involvement opportunity- Phase II. Brochure submitted to the public for comment. Vancouver, B.C. 13 p.

2368 **Tsitika Resource Planning Committee, Public Involvement Opportunity. Phase II. 1978.** Tsitika Resource Management Plan Newsletter. B.C. Forest Service, 355 Burrard St., Vancouver, B.C., V6C 2H1. pp. 1-12.

T111-14 **United Fishermen & Allied Workers' Union. 1978.** Final report on the Tsitika Watershed Integrated Resource Plan. Vancouver, B.C. 7 p.

T111-6C **Volkers, T., and D. Volkers. 1977.** Tsitika River recreation study. Recreation Section, B.C. Forest Services. Victoria, B.C. 69 p.

T111-28 **Western Canada Wilderness Committee. 1990.** Lower Tsitika Valley....

T111-28 **Western Canada Wilderness Committee. 1990.** Lower Tsitika Valley. A Case for Preservation "Changing Forest Values". A report & critique to the Tsitika Follow-up Committee. Victoria, B.C.

T111-14A **Wood, G.A. 1981.** Notes on planning considerations for the lower Tsitika watershed. Victoria, B.C. 13 p.

T111-43 **Wood, G.A., and M.E. Kay Wood. 1986.** The Tsitika-Robson Bight wilderness issue; a submission to the Wilderness Advisory Committee at Nanaimo, B.C., Jan. 22, 1986. Victoria, B.C., V8X 2B8. 15 p.

TSITIKA MOUNTAIN	ER #122
MOUNT DERBY	ER #123
TSITIKA RIVER	ER #124
MOUNT ELLIOT CREEK	ER #125
CLAUD ELLIOT CREEK	ER #126

Many reports listed in Robson Bight Terrestrial Area ER #111 are relevant to the above listed reserves.

Appendix 4

Studies Completed on the Tsitika (1981-1989) and Tsitika Follow-up Committee membership.

Studies completed on the Tsitika (1981-1989)

	Study	Author	Date
1.	Killer Whale and Coastal Log Management. An overview of future uses of Robson Bight (three members of the study team were Tsitika members)		1981
2.	Tsitika Plan Implementation Procedures (must be reviewed by district staff and agencies)		1983
3.	Terrain Stability Mapping and Interpretations	MacMillan Bloedel and Canadian Forest Products Ltd.	1981
4.	Windthrow Studies	Terry Rollerson MacMillan Bloedel	1984
5.	Fisheries Guidelines	Federal Fisheries, Ministry of Environment and MacMillan Bloedel	1982
6.	Introduction of New Methods Minimizing impacts • Line-pulling techniques • Directional falling and yarding • Road-building techniques • Special skidders and forwarder to pick up blowdown • Hoe chucking • Use of a backspar to lift logs over a stream	Forest Companies, Ministry of Environment	ongoing
7.	Evaluation of the Planning Process	Tsitika Follow-up Committee	1982
8.	Channel Morphology Study	E. Karanka	1985-1989
9.	Robson Bight Ecological Reserve -- Background Report	Ministry of Parks	1988
10.	Robson Bight Ecological Reserve -- Evaluation of potential impacts	T. Lewis	1989
11.	Landscape Analysis Studies • Tsitika Landscape Analysis • Video Imagery • Digital Terrain Analysis	Ministry of Forests MacMillan Bloedel	1988 - 1989
12.	Tsitika Plan Status Report		1983-1989

Tsitika Follow-up Committee

Representation	Affiliation	Name
Government agencies	Ministry of Forests	Gary Sutherland (Chairman) Don Huestis Darcy Yule
	Federal Department of Fisheries and Oceans	Mike Brownlee
	Ministry of Environment	Doug Morrison
	Ministry of Parks	Ron Lampard
Labor	International Woodworkers of America	Sy Pederson
	United Fishermen and Allied Workers	Danni Tribe
Outdoor recreation	Outdoor Recreation Council of B.C.	Phil Deardon
Tourism	Stubbs Island Charters	Jim Borrowman
Public		Ed Mankelow
Industry	MacMillan Bloedel	Derek Ferguson Bill Pollard
	Western Forest Products	Cindy Fox
	Canadian Forest Products	Wayne Green

Appendix 5

Management Experience Elsewhere

Appendix 5

MANAGEMENT EXPERIENCE ELSEWHERE

Robson Bight Ecological Reserve is the only killer whale sanctuary in the world. In our efforts to protect killer whales and their habitat, it may be useful to examine the management of other whale species. However, management is very dependent on the biology of the species being protected and caution is required for any extrapolation to killer whale protection.

5.1 International Experience

5.1.1 Mexico

Each fall, gray whales (Eschrichtius robustus) migrate from their feeding grounds in the Arctic to the breeding and calving lagoons on the Pacific coast of Baja California. From north to south, these lagoons include: Ojo de Liebre, Guerrero Negro, San Ignacio, and Magdalena. All but Laguna Magdalena were designated by the Mexican government as refuges in the 1970's in recognition of their importance for breeding. In Ojo de Liebre and Guerrero Negro, no barge or tourist traffic were allowed in some years during the winter breeding season to minimize impacts on the gray whales. However, whale watching, particularly in Laguna San Ignacio, has become an important destination for excursion companies based in San Diego, California. Concerns that U.S.-based tourism was having a detrimental effect on the whales prompted the Mexican government to enact regulations to manage human activities in the Lagoon (Jones and Swartz 1984).

Excursion companies require permits to enter Laguna San Ignacio. In 1987, companies were limited to three day stays and a maximum of three skiffs on the water at any one time (Taylor 1988a). Due to the isolation of the lagoon (in fact, all the lagoons) from commercial shipping lanes, any vessels found within must either have a permit, or be a local fisherman. Geographic isolation enables enforcement to be extremely straightforward and effective. The gray whales tend to control the behaviour of boats within the lagoon.[1]

5.1.2 United States

Humpbacks in Hawaii

Several nearshore areas in the Hawaiian Islands have long been known as winter breeding and calving areas for humpback whales (Megaptera novaeangliae). Increasing levels of vessel traffic, low populations of humpbacks in the North Pacific (~1000), and lack of recovery from whaling have prompted a series of special management actions (NOAA 1987). In response to displacement of cow-calf pairs from nearshore habitat, the National Marine Fisheries Service proposed to limit aircraft approaches to 1000 feet (300+ m.) and boat approaches to 300 yards (300 m.).

---

[1] Gray whales in San Ignacio Lagoon have remarkable "reward and punishment" behaviours which tend to control the actions of boaters. They will solicit touching and other human contact if skiffs carrying people are put into neutral or motor slowly (Jones 1988; Taylor 1988a). However, this whale's reputation for ramming boats which are perceived as threats has earned it the name 'devil-fish'. Such intolerance keeps boaters 'in line', ie. no speeding, no sudden movements, etc.

Concerns regarding the implementation of these regulated limits included:

- boats could inadvertently violate the distance regulations when whales approach vessels, or accidentally approach while not whale watching;
- there is little evidence that current human activity in Hawaiian waters is responsible for poor reproductive rate of North Pacific humpbacks; and
- the regulation seems to target the whale watching industry.

The National Marine Fisheries Service responded as follows:

- a buffer around whales is a more workable solution to protect whale habitat than limiting the number of whale watching vessels through a permit system;
- more long-term studies are needed but this does not preclude the adoption of interim protective measures;
- the regulation would apply equally to all users.

The Hawaiian situation bears resemblance to that in Johnstone Strait in the following characteristics:

- the area is not geographically well-defined as in Mexico and receives high levels of non-whale-orientedvessel traffic;
- humpbacks, like killer whales, tend to avoid vessels when disturbed, and do not show physical aggression towards boats;
- the area's role as critical habitat has not been precisely defined.

Killer Whales in Haro Strait

The southern resident killer whales frequent a core area around Haro Strait in much the same way as northern residents use Johnstone Strait (although they do not rub). However, the southern residents' range is close to large urban centres such as Seattle, Victoria and Vancouver. The increases in frequency of whale sightings and vessel activity have already been discussed (Section 6.2.1). Although there have been no obvious impacts on whale occurrence, a reduction in sleep/rest periods during daylight hours has been noted between 1986 and 1989 (Osborne 1988). Management measures have included more public education programs and research. The growth of charter businesses may have reduced the number of private recreational vessels approaching whales (the effect of 'concentration' discussed earlier). In addition, a land-based whale watching park on San Juan Island equipped with scopes, hydrophones and interpretive displays attracts many visitors who might otherwise be out on the water.

5.1.3 Whale watching management workshop

In 1988, a workshop was co-sponsored by the Center for Marine Conservation and the National Marine Fisheries Service to review and evaluate whale watching programs and management needs. Representatives of industry, conservation, management and the scientific community discussed whale watching programs in Canada, the United States and Mexico. The major conclusion of the workshop was that whales of all species would be better protected if whale watching was more regulated.

Recommendationsfor the future included:

- regulations should be formulated that are simple to understand, follow and enforce;
- minimum approach distances should be legally enforceable;
- regulations should be specific to each region to account for differences in critical habitats, species and behavioural sensitivities, geography, and potential sources of disturbance.

5.2 National Experience

5.2.1 Federal whale watching policy

Problems caused by the growth of the whale watching industry in Canada have stimulated discussion of potential management options by the Department of Fisheries and Oceans (1990). A two stage system is proposed to educate and regulate industry and recreational boaters. While Robson Bight is mentioned as a problem area, the initial focus is to protect endangered whale populations in the Gulf of St. Lawrence, such as the beluga (Delphinapterus leucas).

In stage one, an education and public relations campaign would be instituted to make the whale watching industry and recreational boaters aware of the present regulations[2] and new guidelines for whale watching[3]. This would be coupled with an "aggressive" enforcement campaign in which vessel operators would be charged if in violation of the current regulations. Offenders would be prosecuted on the basis of ignoring guidelines and disregarding conservation-relatedguidelines. At the same time as the education campaign, the Department of Fisheries and Oceans would amend the Marine Mammal regulations to provide for licencing of tour boat operators, under Section 43 of the Fisheries Act. If the education campaign is successful on its own, licencing would not be pursued further. If prosecution on the current bases is inadequate, the Department would follow through with licencing.

If initial measures are unsuccessful in protecting the welfare of whales, the Department would consider amendment of the Fisheries Act itself to regulate the whale watching industry through licencing. Stage two would be pursued only if licencing under the Marine Mammal regulations is ineffective.

---

[2] The Regulations Respecting the Protection of Cetaceans and the Beluga Protection Regulations

[3] Guidelines to Small Craft Owners and Tour Boat Captains to Prevent Any Disturbance and Harassment of the Whales

5.2.2 Beluga protection in the Saguenay River, Quebec

The Department of Fisheries and Oceans and Environment Canada recently published an "Action Plan to Favour Survival of the St. Lawrence Beluga Whale" (1990). The Plan identifies disturbances due to marine traffic as a key factor limiting beluga populations in the Gulf of St. Lawrence.[4] The estuary of the Saguenay River and its confluence with the St. Lawrence are critical beluga habitat. To control disturbance of belugas here, the Department of Fisheries and Oceans has implemented a three-tiered system of guidelines, monitoring and regulation (discussed in 8.2.1). They have also published a set of guidelines limiting vessel approaches to 300 m (included in this appendix).

In early 1990, the Government of Canada and the province of Quebec signed an agreement to create a marine park at the confluence of the Saguenay and St. Lawrence Rivers. A primary goal of the park will be the conservation of resources. A management committee was formed to implement the agreement and carry out an 'Interdepartmental Action Plan to Favour Survival of the St. Lawrence Beluga Whale' (Fisheries and Oceans et al. 1990).

5.2.3 Gray whale watching on the west coast of Vancouver Island

To minimize disturbance of gray whales during migration along the west coast of Vancouver Island, the Department of Fisheries and Oceans published a set of whale watching guidelines in September 1990. The guidelines resulted from consultation with tour boat operators and other interest groups and recommend no approaches closer than 50 m, a 'one boat zone' and a 'no boat zone'.

---

[4] Habitat degradation, primarily the introduction of deleterious substances into the Saguenay River and widespread pollution in the Gulf of St. Lawrence, has been also implicated in the recent decline of this population.

Appendix 6

Guidelines for Whale Watching

- **Barkley Sound and Clayoquot Sound**
- **Johnstone Strait**
- **Robson Bight Ecological Reserve**

Fisheries and Oceans | Pêches et Océans

Marine Mammal Research

Pacific Biological Station
Nanaimo, B.C.
V9R 5K6

September 1990

Your file *Votre référence*

Our file *Notre référence*

WHALE WATCHING GUIDELINES

For Barkley Sound to Clayoquot Sound

By following these boating guidelines you will minimize whale disturbance, still view the whales natural behaviour and allow other people to enjoy whale watching as well.

GETTING INTO POSITION

- Approach the whale from its side or rear, not head on.
- Parallel the whale, match its speed and gradually move closer.
- Use dead slow speed (no wake) when within 100 m of the whale.

FOLLOWING THE WHALE

- When viewing a whale you should maintain a distance of at least 100 m from it.
- A single boat may approach up to 50 m of the whale, but not for more than 15 min.
- If the whale avoids your boat increase your distance from it.
- If the whale closely approaches your boat, stop until it moves at least 50 m away.
- Do not suddenly alter boat direction or speed.
- All boats should remain on one side of the whale and in radio contact with each other.

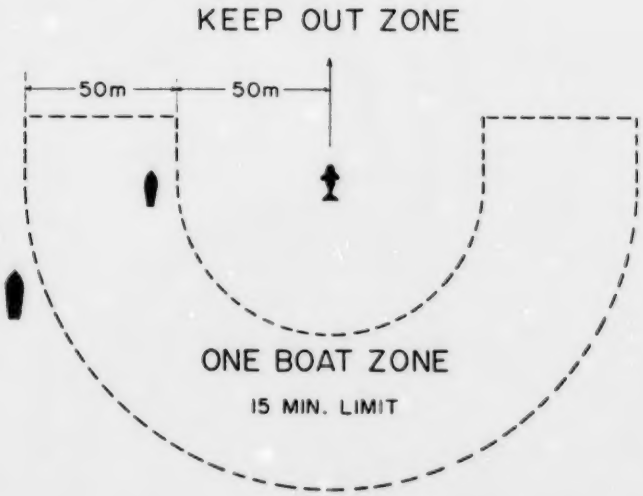
LEAVING THE WHALE

- Depart slowly until at least 100 m from the whale.

Note

Whales are protected from harassment under the federal Fisheries Act.

Pace out 50 m and 100 m on land so that you will recognize this distance on the water.



Canada

Phone (604) 756-7000 Facsimile 756-7053 Telex 044-6128

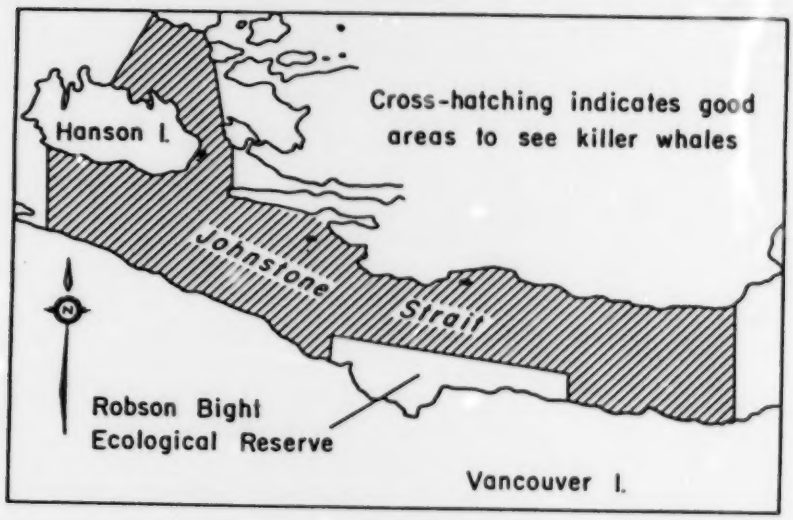
Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

June 1985

Your file / Votre référence

Our file / Notre référence

ATTENTION WHALE WATCHERS



To ensure that killer whales are not disturbed, please stay at least 100 metres away in Johnstone Strait and at least 300 metres away in the Robson Bight Ecological Reserve. Research boats flying a numbered yellow pennant may approach closer when essential for study.

It is important to remember that harassing killer whales is an offence under the Federal Fisheries Act. Also, an Ecological Reserve was established in the Robson Bight area to allow these whales to feed and rest undisturbed. A permit is required from the British Columbia Parks and Recreation Division (1019 Wharf Street, Victoria, B.C. V8W 2Y9) to undertake research in the reserve.

The reverse side of this notice explains how to approach killer whales in your boat, and provides some biological facts about pods.

Marine Mammal Research
Pacific Biological Station
Nanaimo, B.C.
V9R 5K6

Station de biologie du pacifique
Nanaimo, (C.-B.)
V9R 5K6

How to approach killer whales

The following guidelines will help you approach killer whales in your boat with a minimum of disturbance to the whales and to other whale watchers.

1. Approach whales from the side, not the front or rear.
2. Make your approach and departure slowly.
3. When travelling beside whales (100 m away in Johnstone Strait; 300 m in the Robson Bight Ecological Reserve) maintain a speed of 2-4 knots, and do not alter your speed abruptly. Whales surface for about 3 breaths, and dive for 3-4 minutes.
4. Be considerate of other whale watching boats, so that everyone has a chance for a good view, and where possible, lessen congestion by observing an unwatched pod.
5. Whales are particularly susceptible to disturbance when resting on the surface as a group.
6. On occasion, you may see a research boat approach the whales more rapidly or closely than is recommended for general observation. This research usually involves censusing, or documenting the behaviour of individual whales. Each whale is recognizable from unique natural markings. Research boats are identified by a numbered yellow pennant. Pennants with a black tip indicate a permit has been obtained to undertake research within the Robson Bight Ecological Reserve.

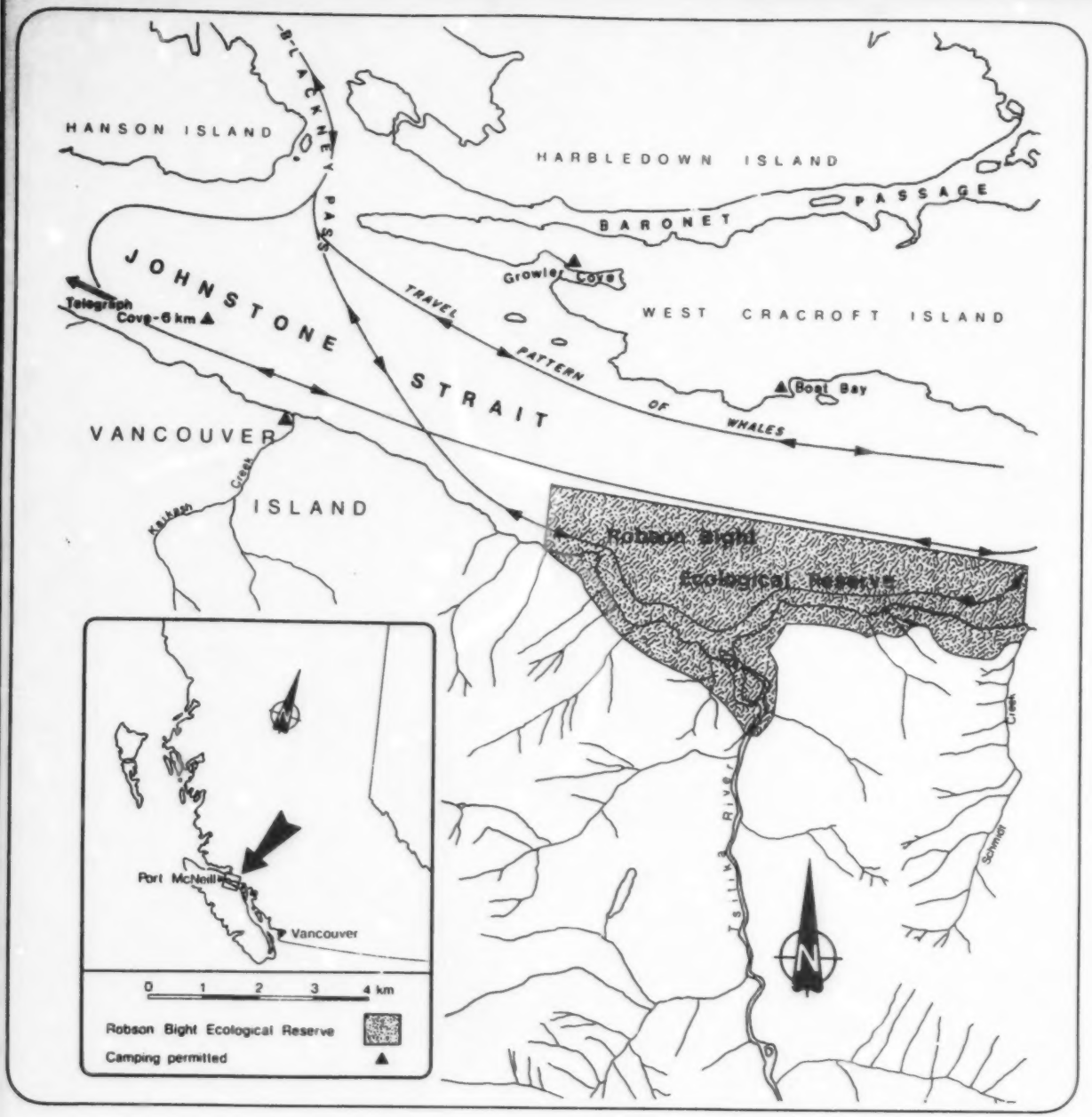
Some facts about pods of killer whales

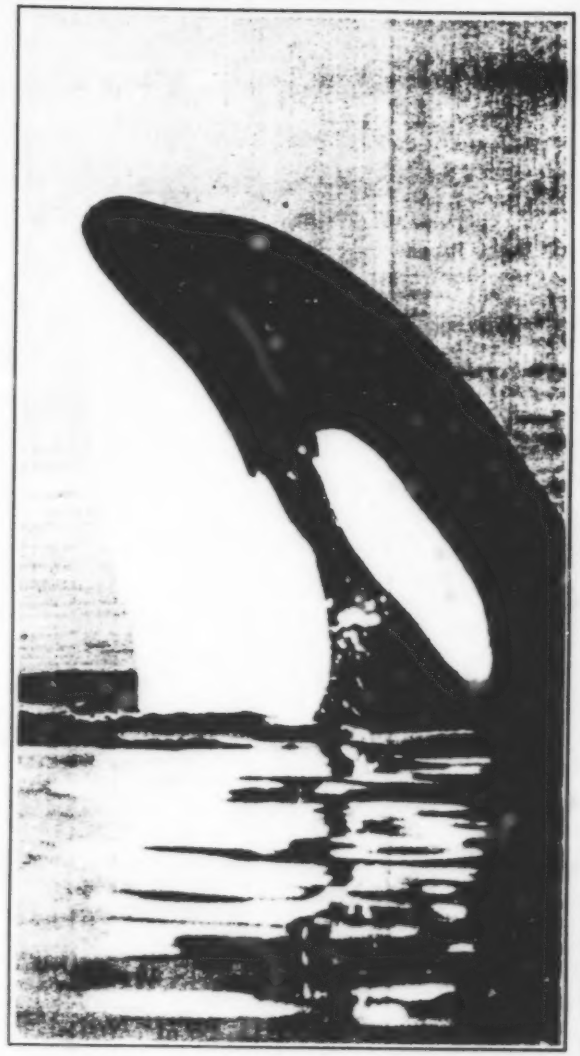
Killer whales live in remarkably stable social groupings called pods that are only now beginning to be understood. A typical pod has 5-20 individuals, but can have up to 50. The average pod contains a mixture of males and females of various ages, and is organized into 2-3 subgroups. Each subgroup is composed of a cow with her offspring, and can number up to 5 animals. Cows within a pod are apparently closely related. A few other individuals are usually present in the pod, and these too are probably related to the cows. Whales within a pod appear to remain together throughout their lives. Males may live up to 50 years, and females up to 75 years. A new pod probably forms by the gradual splitting of an existing pod, along maternal lines. Each pod has its own unique dialect.

When travelling, a pod sometimes disperses over an area of several square km, while at other times it keeps in close formation. Different pods travel together for short periods, and this can result in a large group. Three communities of killer whales are known in British Columbia. One is found off southern Vancouver Island, and contains 3 pods with 75 whales. Another inhabits northern Vancouver Island, and contains 13 pods with 150 whales. The third community travels throughout British Columbia, and contains 17 pods with 50 whales. All pods within a community travel together at some time, but pods from one community do not mix with those from another. Killer whales are seen in British Columbia all year, but are most common during July-September.

Robson Bight Ecological Reserve

BC Parks

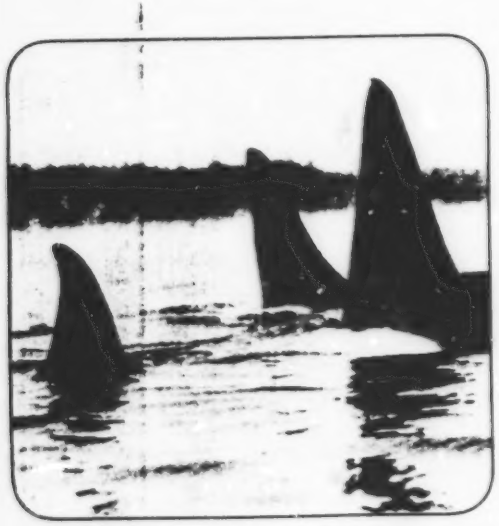




Robson Bight Ecological Reserve

The 1248 ha marine portion of Robson Bight Ecological Reserve was established in June, 1982 to protect a core habitat of the killer whale for research and educational purposes. An upland buffer zone of 505 hectares was added to the reserve in 1988 and 1989.

Robson Bight is a killer whale (Ornicus orca) sanctuary. Scientific observations have concluded that boating traffic including kayaks and canoes can be very disruptive to the killer whales' resting and socializing patterns in the bight. **Please stay well away from whales in the bight area.**



Guidelines For Observing Killer Whales

Ecological reserves are not established for the benefit of human recreation but for the benefit of wild species and their environment. **Boaters should refrain from entering the reserve when whales are present**. Whales can easily be observed elsewhere. (See map.) To avoid disturbing the whales and for your safety, you should follow these guidelines:

1) Do not follow whales into the reserve.
2) Should you stray into the reserve, keep at least 300 metres away from the whales. Only researchers identified by a yellow pennant are issued permits to observe whales at closer range in the reserve.
   Whales may be approached to within 100 m outside the reserve without a permit.
3) Approach whales from the side; not from the front or the rear. Approach and depart slowly. Avoid disturbing a "line" of resting whales.
4) When travelling beside whales, maintain a speed of 2 to 4 knots; do not alter your speed abruptly.
5) Keep noise levels down — no horns, whistles, shouting or racing of motors.
6) Be conscious of the effect of your actions on the whales. Do not engage in any activity which disturbs or molests them. **It is illegal under Federal Fisheries Regulations, Section 71 (A) (2) to disturb or molest killer whales.**

Camping

Camping, lighting fires and any form of consumptive use is not permitted within an Ecological Reserve. Visitors may camp at Telegraph Cove, Kaikash Creek, Boat Bay or Growler Cove on West Cracroft Island. (See Map.) The last two sites have good anchorages and are excellent locations for whale watching; however, neither has fresh water.

About Killer Whales

A killer whale pod, or family group, usually consists of five to 20 bulls, cows and juveniles. Each whale is recognizable by its unique markings and each pod is always composed of the same individuals and has its own dialect. About 30 pods totalling 300 whales occur year around in British Columbia and Washington coastal waters. Nineteen pods (170 whales) are seen in Johnstone Strait.

Killer whales travel at 6 to 8 km/h, sometimes as a tightly-knit group and at other times dispersed over a few square kilometres. Periodically, groups join with one another and are then spread over several square kilometres. The dive sequence consists of one long dive lasting 3 to 4 minutes followed by three short dives of 15 to 20 seconds.

Killer whales range in length from 2.5 m at birth to 8 m for mature females and 9 m for mature males. Cows probably live to a maximum of 75 years and bulls to 50 years. On average a cow gives birth only once every ten years.

Whales rest in lines, abreast of each other, synchronizing their breathing. They are particularly susceptible to disturbance at this time.

For more information on killer whales or Ecological Reserves, write to:

Ministry of Parks
Planning and Conservation Services
4000 Seymour Place
Victoria, B.C.
V8V 1X5 (604) 387-5002

ISBN 0-7719-9799-X

Printed in Canada
Queen's Printer for British Columbia Victoria 1990